PRACTICAL ENGINEER

Trade-mark reg. U. S. Pat. Office.

VOL. XVI CHICAGO, OCTOBER 1, 1912 No. 19

HEATING AND VENTILATING A FACTORY

Power Free from Steam Needed for Rubber Manufacture and Heating; Heat Necessary in a Reinforced Concrete Building

DESIGN OF THE POWER generating equipment of a modern factory is largely, and in some cases primarily, based upon the demands of the plant for heat, both for heating the buildings and for industrial processes. If a considerable percentage of exhaust steam can be utilized in heating or drying coils or in calendering rolls, vulcanizers, evaporators, dye tubs, cooking kettles, etc., power may be produced on the basis of a byproduct. In other words, the cost of boiler equipment and the expense for fuel would be necessary in any case to supply the demands for heat, and the production of power becomes merely an incident, involving no costs further than for engines and generators and for the care and attention which they must receive.

In many instances the demands for heat are so great that no exhaust steam is wasted at any period of the year, the exhaust steam being rather supplemented with live steam when there is an exceptional demand for heat, as in the winter. Where, on the other hand, the demand for exhaust heat during the winter about equals the output of the engine, in the summer there is generally a certain percentage of exhaust steam which must be allowed to escape to the atmosphere or be condensed.

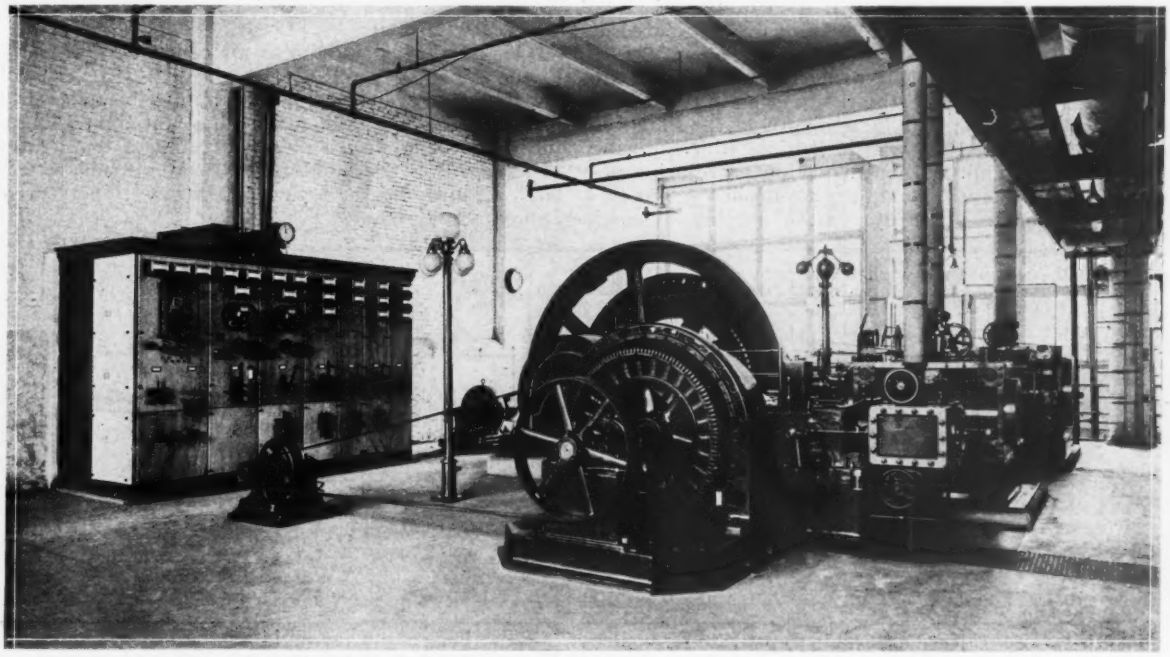


FIG. 6. THE SMALLER GENERATING UNIT AND THE SWITCHBOARD

In the rubber mill and rubber goods factory which we are about to describe, the demands for heat for

warming the building and for vulcanizing, drying, etc., are so great that all of the exhaust is consumed during half of the year or more and only a small percentage escapes to the atmosphere even in the summer months. This is partly due to the fact that the lighting load is much less during the season when the least heat is required.

Heat Requirements

THE plant described is that of the Lee Tire & Rubber Co., formerly the J. Ellwood Lee Co., of Conshohocken, Pa., manufacturers of rubber tires and inner tubes, trusses, elastic bandages, catheters, rubber gloves, nipples, hot water bottles, ice bags, etc. As

FIG. 1. HECTOR STREET BUILDING OF THE LEE TIRE & RUBBER CO.'S PLANT

may be inferred from the cuts herewith, the heating requirements were somewhat more exacting than ordinary, due to the large amount of glass surface relative to total wall surface. For instance, in the large 4-story building, hereinafter referred to as the Hector St. mill, which contains a total of 1,726,540 cu. ft., there are 44,300 sq. ft. of glass surface, as against only 6328 sq. ft. of concrete wall and 29,800 sq. ft. of concrete roof. The maximum heat loss for this building was estimated at 4,605,000 B.t.u. an hour.

Heating and ventilating problems in this case are made still more numerous by the nature of the processes carried on in the buildings, involving the handling of rubber dissolved in volatile liquids, which, during manufacturing and subsequent drying processes evaporate in large quantities into the atmosphere. For this reason, rather than because of the number of occupants, it was considered advisable to provide for changing the entire air contents of the main floors of the buildings every 18 min., and of the basement every 22 min.

Heating Equipment, Hector St.

THE large 4-story Hector Street mill is divided at the middle by a fire wall, and for this reason among others it was considered advisable to provide 2 heating equipments. These are exactly alike, each consisting of a Green hot-blast heater outfit, located on the fourth floor and comprising a double discharge full housing fan, a Positiv-flo steam air heater and a horizontal engine. Each heater contains 80,240 lineal ft. of 1-in. pipe and the fan delivers 48,900 cu. ft. of air per minute against a pressure of ¾ ounce per sq. in.

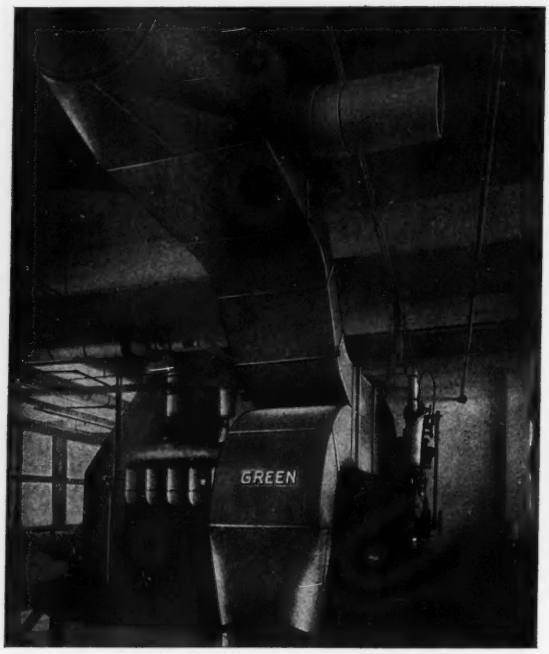


FIG. 3. GREEN HOT-BLAST HEATER OUTFIT IN RUBBER MILL

Air is taken from a fresh air connection extending to the roof and is heated to 140 deg. In very cold weather, however, part of the air may be taken from inside the building and recirculated, the dimensions of the outfit being based on maintaining a temperature of 70 deg. F. in the building with zero outside, recirculated air entering the heater at a mean temperature of approximately 50 deg. F.

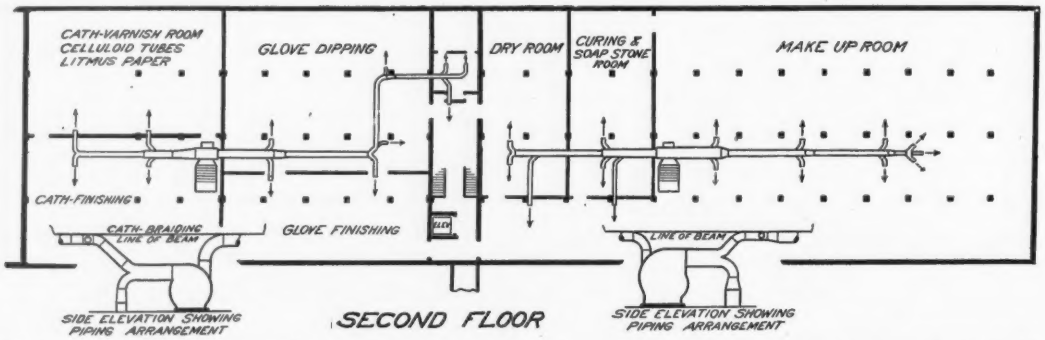


FIG. 2. ARRANGEMENT OF GREEN HEATING EQUIPMENT AND AIR DUCTS ON SECOND FLOOR OF RUBBER MILL

Another reason for dividing the heating equipment into 2 parts is found in the dimensions of the building, which is 400 ft. long by 85 ft. wide. Each of the 4 stories is 14 ft. high. Even as installed, over 10 tons of galvanized iron were required in the duct work for this building. A large vertical duct leads the air from the fan to the several floors, where, as may be seen from the illustrations, horizontal branched ducts run along the ceilings with outlet nozzles on either side to

discharge the air down against the floor, thereby delivering the air into the space occupied by the workmen.

Rubber Mill Requirements

THE Rubber Mill is a much smaller building, having a total length of 330 ft., a width of 82 ft., and 2 stories, each 14 ft. high, making the total contents 658,560 cu. ft. This building is also divided by a fire wall into 2 parts, but these are not equal and the heating equipments installed are therefore of different sizes. The right hand side of the building, having a total contents of 416,640 cu. ft., a total glass surface of 11,074 sq. ft., a total wall surface of 1582 sq. ft., and a roof area of 14,880 sq. ft., was estimated to require 1,038,000 B.t.u.s an hour, and with an 18-min. change to require 23,160 cu. ft. of air per minute. Using exhaust steam in the heater, 3850 actual lineal feet of 1-in. pipe were allotted in the Green hot blast heater for heating the air from 50 deg. to 140 deg. F. which was considered sufficient to maintain a temperature of 70 deg. F. in zero weather. The similar quantities for the left hand end of the building are: contents, 241,920 cu. ft.; glass surface, 6276 sq. ft.; wall surface, 896 sq. ft.; maximum heat loss, 467,000 B.t.u.s. an hour. The air required for an 18-min. air change is 13,440 cu. ft. per minute, and to heat the air from 50 to 140 deg. F., a Green hot blast heating outfit consisting of a Positiv-flo heater of 2250 actual lineal feet of 1-in. pipe and a ¾ housing fan, driven by a vertical engine, were installed. The galvanized iron work for this building weighed 3 tons.

All heating and ventilating and other heat requirements throughout the building are, as far as possible, met by the use of exhaust steam. This is supplied by an 18 and 28 by 36 cross-compound engine, an air compressor, a boiler feed pump, a tank pump; a vacuum pump for 2 vacuum driers, one used for drying cloth and the other for rubber; a vacuum pump for the heating system, and a 12 by 12 direct connected lighting engine.

Exhaust from all units is gathered into one exhaust main, which leads to a Cochrane open heater, in the separator of which the steam is purified of oil before passing to the exhaust steam distribution system. A reducing valve provides for furnishing live steam when the supply of exhaust is insufficient. The small engines driving the fans also exhaust through separators directly into the corresponding hot blast heaters. Exhaust steam is also used for preventing freezing of the water in the fire protection tank, and also for some nearby hot beds belonging to the proprietors of the establishment.

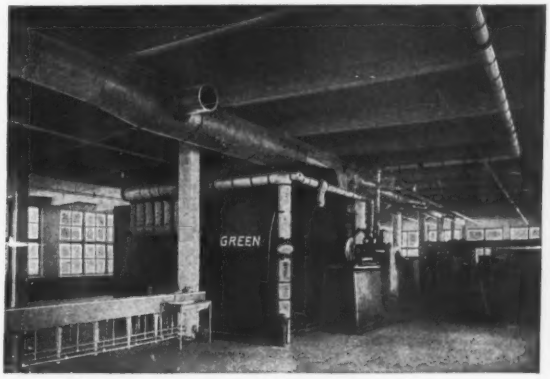


FIG. 5. HOT BLAST HEATER OUTFIT OF GREEN SYSTEM IN LEFT HAND END, 4TH FLOOR OF HECTOR ST. BUILDING

Water Saving and Treatment

MOST of the radiators, calendars, etc., are fitted with automatic air valves and the air and water are delivered by the vacuum pump into a tank about 10 ft. above the heater. The hot blast heaters, however, are located at a sufficient height to return the condensate by gravity, the drop being sufficient to overcome any vacuum which may be carried on the system.

Due to the careful utilization and conservation of all condensate and drips, very little make-up water is required for the operation of the plant, the little needed

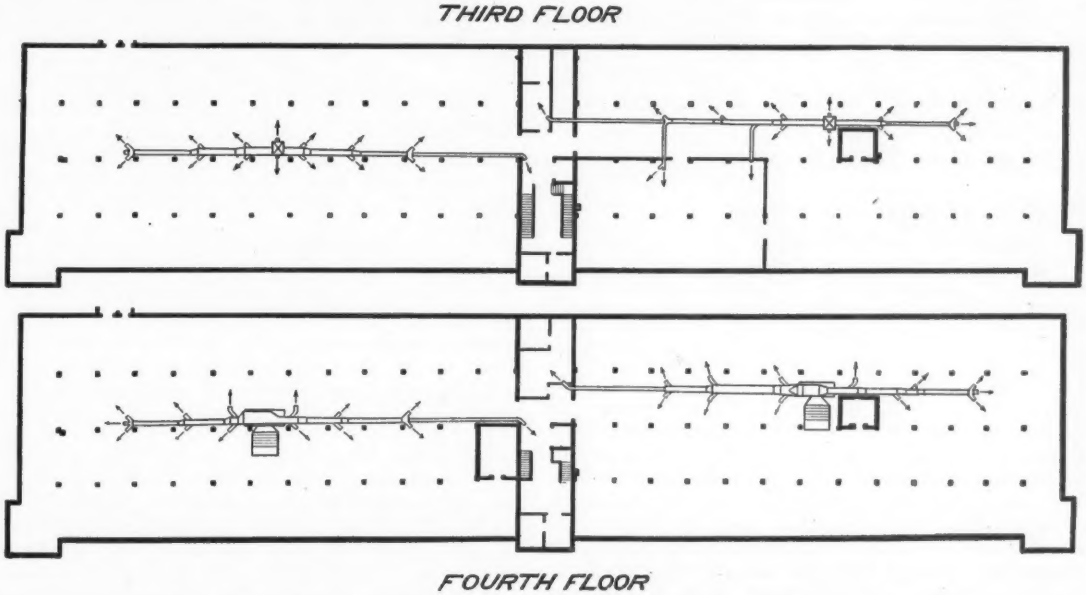


FIG. 4. HEATER AND PIPING LAYOUTS OF GREEN SYSTEM IN HECTOR ST. BUILDING

being taken from an artesian well. After heating and treating with soda ash in the heater the boiler feed water is pumped, at a temperature corresponding to the back pressure or vacuum in the heater, through a Green's Economizer of 6000 sq. ft. of heating surface into the Heine boilers.

The stack of this plant is 150 ft. high, giving a draft of 2 in., and serves not only for the boilers but also to dispose of the sulphuric acid fumes from the rubber vulcanizers.

During the summer, advantage is taken of the possibility of using the Positiv-flo heaters for cooling the air, water from the artesian well being circulated through the tubes of the heater and overflowing into the reservoir. The Positiv-flo heater lends itself exceptionally well to this service, since the flow is positive from inlet to outlet. The pipes are arranged horizontally between 2 vertical headers and it is possible to examine the individual tubes and to remove scale or other accumulations from the interiors of the pipes after taking off the covers from the headers.

During the exceptionally cold weather of the last season the heating of the buildings was most satisfactory. The design of the plant as a whole is due to Mr. Broadnax, of New York, N. Y., while the hot blast heating equipment was designed and supplied by the Green Fuel Economizer Co., of Matteawan, N. Y.

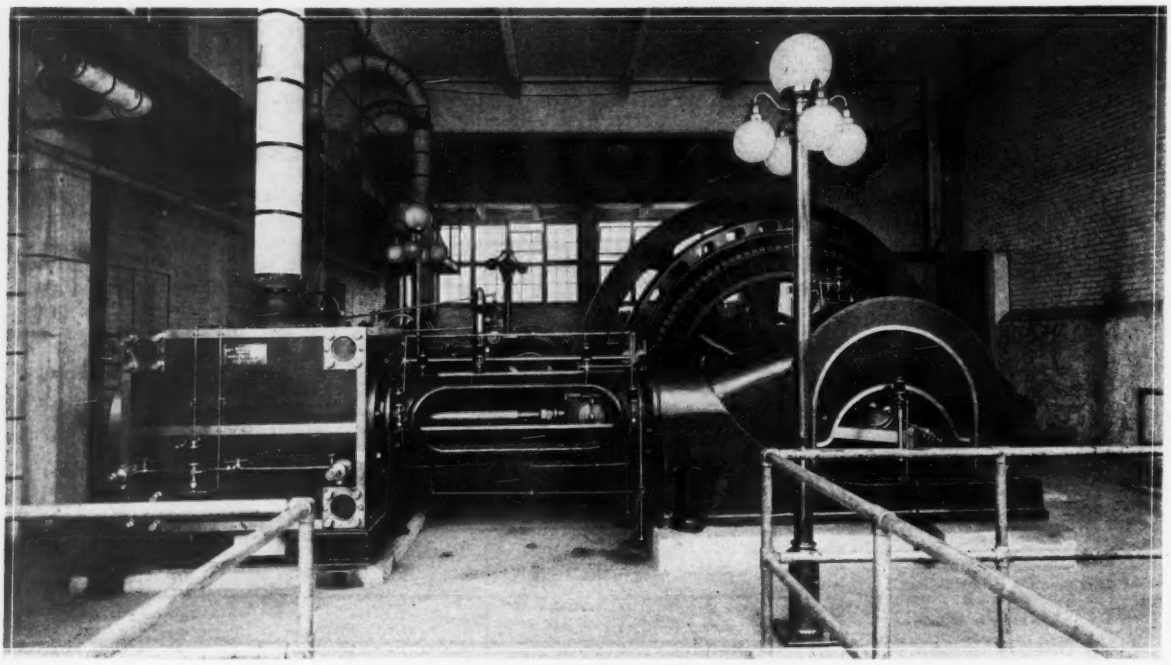


FIG. 7. THE LARGER GENERATING UNIT AND PIPING

SOME PREFER a mixture of fireclay and cement for plastering the walls of furnaces and combustion chambers, but it is best to use fireclay alone, as the heat takes all the water out of the cement, leaving the fireclay to crumble and fall from the walls. A mixture of fireclay and salt is good to preserve the walls, making a glazed surface to which soot will not adhere. Five shovelfulls of fireclay to one of salt gives good results, but it must be mixed thoroughly.—Penberthy Engineer and Fireman.

BOILER SETTINGS

BY EVERARD BROWN

WILL an ordinary brick setting of the best material and workmanship and in first class condition exclude air? That is, will it prevent the infiltration of air sufficiently well so that there is no appreciable loss in economy? A very simple experiment will answer this question and, as it will cost nothing but a little time on the part of the station engineer, it is well worth trying.

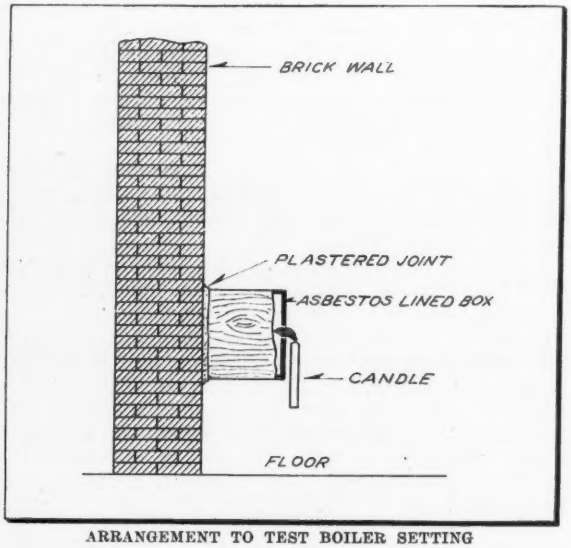
Take an ordinary soap box of fairly good size and line it carefully with asbestos or some other material so that no air can filter through. The cover can be left off as it is not needed, then bore a small hole, say ½ in. in diameter, through the bottom of the box and the lining. Prop it up tight against the setting with the open side next to the brick work and plaster up the joints all around so that no air can get in between the box and the brick work. Reference to the accompanying sketch will show clearly the idea. Now by applying a lighted candle in front of the small hole in the box it will be found that the draft through it will, in many cases, be remarkably great. It must be remembered also that the box covers only, perhaps, 4 or 5 sq. ft. of the surface of the setting so that when the entire setting is considered the total amount of air filtered through the walls must be rather large.

This condition may be accounted for in several ways but it is probably due more to the porosity of the materials entering into the construction of the setting than to any other one thing. It is, of course, true that some kinds of brick are more porous than others, nevertheless, water enters into the manufacture of all and when the brick is dried out this water is evaporated, consequently small spaces result through which air can pass. The same argument will also hold good for the mortar used in laying the brick.

Naturally a great deal depends upon the man putting up the setting as well, and it should be seen that all joints are thin and well made.

Not long ago a station engineer thought he was burning a large amount of fuel in proportion to the amount of water evaporated and he tried the above experiment. He found that the inrush of cold air through the boiler settings was enormous and immediately looked around for a remedy. He finally decided than an "overcoat" was needed for the settings so he first procured some long wire nails and drove them into the joints of the brick work about 2 ft. apart, leaving about ½ in. of the nails project from the face of the wall. Wires were then strung from nail to nail diagonally as well as vertically and horizontally, thus forming a net work of wires which made a very suitable foundation and on which he put a covering of asbestos cement about ⅝ in. thick. Over this he put a layer of heavy canvas and added a coat of good paint.

As the engineer was not positive that a saving would result that would justify this expenditure he only covered one setting in his boiler house and then



ARRANGEMENT TO TEST BOILER SETTING

watched for results. He discovered that a saving of 10 per cent in the amount of fuel burned under this particular boiler was effected and he at once began covering all of his settings in the same way. In figuring up the fuel consumption for the month following the completion of this work it was found that the fuel bill was about 10 per cent less than for any previous month. It might be added that this saving has continued ever since. The settings in this case, however, must naturally have been in very poor condition or the savings would hardly have been so large.

There are several ways of applying an "overcoat" to a boiler setting. For example, instead of stretching single wires from nail to nail over the surface of the brick work, a wire mesh may be used or a light metal lath.

Concerns are now making a business of doing this kind of work in connection with pipe covering, etc. They usually apply asbestos cement boards or blocks about 2 in. thick. These boards are held in place by either vertical or horizontal steel strips(usually the former), which are fastened by small bolts set in certain joints as the brick work is put up. The joints between the edges of these boards are filled in with a plastic asbestos cement and the whole is then covered with heavy canvas and painted. The steel strips are usually put on outside the canvas, however, so as to hold it rigidly in place.

There is also a metal covering that is advocated by some. This is merely a covering of comparatively thin steel plates. It has some disadvantages, however, that might work against its adoption. For instance, all of the joints must be well calked to make them absolutely air tight and, because of contraction and expansion, the plates have a tendency to warp and buckle. If they should do this, even to a slight degree, leaky joints will naturally follow. With a steel covering of this kind it is impossible to get at the inside of the plates to paint or otherwise protect them from corrosive action to which they would be subjected, so that the life of the plates might be comparatively short.

The purpose of a covering for a boiler setting should be two-fold; to prevent air infiltration and to reduce radiation to a minimum. No doubt the large saving in fuel previously mentioned, as the result of a covering, is due partly to the insulation caused by the asbestos cement. In this respect, therefore, an asbestos or magnesia composition is preferable to a steel cover.

Where, on account of local conditions, it is necessary to support both the boilers and settings on the floor beams of the building as is often the case in some of the power plants in our large cities, a covering has a peculiar advantage in that it permits of the use of hollow tile for the setting, thus making a comparatively light construction. The tile is used, not because it affords an air space in the walls of the settings, as this is of doubtful value, but because a tile setting with a proper lining of fire brick and a good outside cover makes a light construction that has been found practically as good as the solid brick. It is also somewhat cheaper than the latter both in itself and because of the lighter building structure necessary to support it. There are a number of installations of this kind in existence, particularly in the middle west, where the results have been very satisfactory.

SOME INTERESTING AND COMPLETE FIGURES

By Ernest Stevens

HAVING seen a request in your paper for data, etc., in regard to isolated plants, I am sending you a description of the Boston Safe Deposit & Trust Company Building and plant, also a complete record of one year's operation. I am also enclosing one of our daily log sheets which I prepared for this particular plant.

There is no doubt that the failure to keep such a record is one of the biggest helps to the central station, for it leaves the engineers and owners in complete ignorance of their own plant, and they have nothing with which to refute the figures that may be submitted by a central station agent.

Let us hope that every engineer who has charge of an isolated plant, no matter how small, will start at once and keep a complete log of his plant. A properly kept record of an isolated plant is an efficiency builder as well as a central station excluder.

The building is of white Vermont marble, of fireproof construction, and was erected in 1909. It is 10 stories in height, with 2 basements, and covers a plot 110 by 125 ft. The first and second floors and the

first basement are occupied by the owners. The other 8 floors are rented as offices, having, approximately, 9,237 sq. ft. of rental space on each floor.

Equipment of Plant

THREE American Ball engines, 13 in. by 11 in., 275 r.p.m., direct connected to 3 50-kw. Westinghouse 3-wire generators.

Switchboard of blue Vermont marble, equipped with recording voltmeters and ammeters, also recording wattmeters.

Three 153-hp. Heine water tube boilers, each having 1,530 sq. ft. of heating surface, grates of 30 sq. ft. to each boiler, with balanced draft system of pressure control.

One 500-hp. Davis feed water heater and a Blackburn & Smith feed water filter.

Two 7½ in. by 5 in. by 6 in. Warren outside packed plunger feed pumps.

One Worthington water weigher (12,000 lb. per hr.).

One 300-gal. hot water heater taking steam through Mason reducing valve at 150 lb. pressure.

Double system of piping throughout boiler and engine rooms.

Coal storage space for 125 tons of fuel.

Two Loomis-Manning water filters which filter all the water entering building.

One 15-hp. Westinghouse motor belted to Sanitary Vacuum Cleaning machine.

Two 6½-hp. Jenney motors direct connected to Yeoman sewage ejectors (float controlled).

Two Lamson Hubbard book lifts (Holtzer-Cabot motors.)

Three magnet control Otis electric elevators.

Four Otis plunger elevators, serving tenants of building above second floor.

Two Otis plunger elevators (short lifts).

One Laidlaw-Dunn-Gordon pump, 17 in. by 20 in. by 20 in. by 10 in. by 18 in.

One duplex Deane pump, 24 in. by 16 in. by 18 in.

One duplex Deane pump, 9 in. by 5¼ in. by 12 in.

Two pressure tanks, 84 in. by 14 ft.

One open tank, 8 ft. by 15 ft. by 10 ft.

Johnson service duplex air pump, 2½ in. by 2 in. by 6 in., supplying air at 15 lb. pressure for diaphragm valve with air controlled by thermostats.

Twenty-five hp. Sturtevant motor operating Warren, Webster & Co., air washer fan, delivering 4,500 cu. ft. of air per min. to banking rooms for ventilation; air heated to 70 degrees in cool weather.

One 9½ in. by 7 in. by 10 in. Westinghouse air pump to supply air to elevator tanks.

One 7½-hp. Crocker-Wheeler motor, direct connected to centrifugal pump for supplying water to washer.

One 15-hp. Sturtevant motor driven exhaust fan; a pressure above atmosphere is maintained in banking rooms, so that no outside air can leak in. Washer and radiators in bank are controlled by Johnson thermostats.

One 3-hp. Sturtevant motor-driven fan for ventilation of toilets of building.

One 8-hp. Sturtevant motor-driven fan furnishing air for boiler and engine rooms which are 40 ft. below street.

Three motor generator sets for bell circuits.

One 1½-hp. Jenney motor connected to sump pump with float control.

Tungsten lamps used throughout the building.

The power plant is operated 24 hr. a day by 3 engineers and 2 firemen.

Light is sold to tenants of building. Each tenant has a meter and is charged the same as central station rate.

Total cost of operating plant from November1, 1910, to October 31, 1911, was $12,981.69. This includes all money spent in any way for the plant. This is subdivided as follows:

Fuel	$ 5,912.95
Labor	4,964.00
Supplies, repairs, etc.	1,530.24
Water for boilers	300.00
Ash removal	274.50
Total	$12,981.69

Work developed by the plant:

Heating

HEATING 2650 sq. ft. forced indirect (using 4500 cu. ft. of air per minute).

12,297 sq. ft. semi direct.

2742 sq. ft. direct.

Other Service

ELEVATORS: 17,738 car miles.

Hot water service: 8½ boiler hp. per hour.

Electric current generated: 257,900 kw.-hr.

And accessories using steam, such as Westinghouse air pump, feed pumps, Burke system, Johnson service air pump and siphon ejectors.

The average evaporation for year was 9.36 lb. water per lb. of fuel; 3,986,280 lb. fuel used, which was 3 parts screenings to one part bituminous coal. Fuel cost per ton was $2.96.

Allowing 30 lb. of steam per hp.-hr., and deducting ½ of 1 per cent of all steam generated for condensation in steam lines, we have:

3,986,280 lb. of fuel × 9.36 — (½ of 1 per cent) = 37,125,023 lb. of steam used per year. This ÷ 30 gives us 1,237,501 hp.-hr. developed per year. $12,981.69 ÷ 1,237,501 = $.01049 cost per horsepower-hour net. $.01049 × 1⅓ = $.01399 net cost per kw.-hr. at switchboard. Fuel cost to evaporate 1,000 lb. of water $.158.

The horsepower per year and costs are subdivided as follows:

	Horsepower hour per year.	Cost per year.
Elevator pumps	354,244	$3,719.71
Heating building	400,495	4,204.95
Electricity	343,866	3,610.74
Hot water system	74,460	781.86
Accessories	64,436	664.43
Total	1,237,501	$12,981.69

Cost of Plant.

Boilers, piping and accessories	$30,000.00
Engines, generators and switchboard	9,900.00
Elevator pumps	9,900.00
Total	$49,800.00

Allowing 5 per cent for interest, 5 per cent for depreciation and 2 per cent for insurance and taxes, we have a total fixed charge of 12 per cent and 12 per cent of $49,800.00 ÷ 1,237,501 horsepower hours = $.00483 as the cost of fixed charges per hp.-hr. $.01049 + $.00483 = $.01532 total cost of one horsepower-hour. $.01532 × 1⅓ = $.020429 total cost per kilowatt hour.

The cost of plant does not include elevators, sewage ejectors, vacuum machine, city water filters, elevator tanks or elevator piping.—The Isolated Plant.

BOILER QUESTIONS

Pump Pressure to Feed Through the Check Valve; A Lesson in Practical Boiler Room Arithmetic

By Wm. F. Fischer

REGARDING unbalanced pressure on the check valve asked for by H. C., in the Aug. 1 issue of practical Engineer, I wish to offer the following general solution, which may be applied to all similar cases. In Fig. 1 we have the pump pressure P acting on one side of the check valve tending to open it against the boiler pressure p which tends to keep it closed As the surface y of the disk exposed to the boiler pressure is greater than the surface x, the pressure per square inch acting on surface x must be greater than that acting on surface y in order that the total pressures acting in each direction may be balanced; or in other words the total pressure acting on x should equal the total pressure acting on y, after which a slight increase in pressure on the pump side will cause the disk to open, admitting water to flow to the boiler.

Total pressure on the boiler side, y, will be the boiler pressure, p, per square inch times the area of y; and total pressure on the pump side, x, will be pump pressure

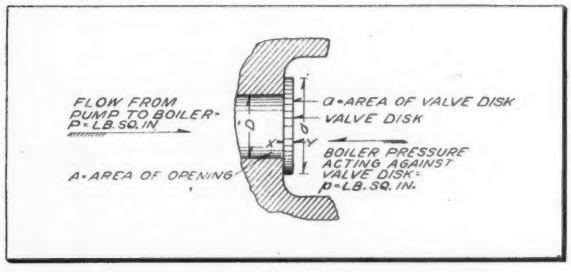

FLOW FROM PUMP TO BOILER-P-LB. SQ. IN.
a-AREA OF VALVE DISK
VALVE DISK
A-AREA OF OPENING
BOILER PRESSURE ACTING AGAINST VALVE DISK-P-LB. SQ. IN.

FIG. 1. CHECK VALVE AREAS AND ACTION

per square inch, P, times area of x. If we denote area of y by a and area of x by A we could denote the total pressure on y by $p \times a$, and total pressure on x by $P \times A$, and these two must be equal to have the forces balanced so that the valve will be on the point of opening, or

$$p\,a = P\,A \qquad (1)$$

Now the area, a, of y, being a circle, is the diameter square time .7854, and likewise for x. If we denote the diameter of y by d and of x by D we may express shortly by writing,

$$a = d^2 \times 0.7854 \qquad (2)$$

$$A = D^2 \times 0.7854 \qquad (3)$$

In the expression (1) we may, evidently, put in place of a and A their equal values from (2) and (3), and we shall then have,

$$p \times d^2 \times 0.7854 = P \times D^2 \times 0.7854 \qquad (4)$$

Suppose that both sides of this expression or formula be divided by 0.7854, it will not destroy the equality. To prove this take an actual problem in figures. Let p = 100 lb., d = 2 in., P = 120 lb., D = 1.82 in.; then we get the result of Fig. 2 or 314.9 = 314.9.

Divide each side by 0.7854, expressing the division, and we have, as in Fig. 2, the second form of the equation, in which we can cancel 0.7854 in numerator and denominator on each side. Then working out the values, 400 = 400.

From this we get the general rule that both sides of an equation or formula or expression of equal values may be divided or multiplied by the same number or quantity without altering the truth of the expression of equality; performing the division and cancellation on formula (4) we get, as in Fig. 2,

$$p \times d^2 = P \times D^2 \qquad (5)$$

Studying this expression we see that P, the pump pressure is the value wanted; for H. C. gives the boiler pressure p as 100 lb., the diameter of valve d as $1\frac{7}{8}$ in., and the diameter of opening D as $1^9/_{16}$ in. If we divide

$$100 \times 2 \times 2 \times 0.7854 = 120 \times 1.82 \times 1.82 \times 0.7854$$
$$314.4 = 314.9$$
$$\frac{100 \times 2 \times 2 \times 0.7854}{0.7854} = \frac{120 \times 1.82 \times 1.82 \times 0.7854}{0.7854}$$
$$400 = 400$$
$$\frac{p \times d^2 \times 0.7854}{0.7854} = \frac{P \times D^2 \times 0.7854}{0.7854}$$
$$p \times d^2 = P \times D^2$$

FIG. 2. DIVISION OF EQUATIONS BY A NUMBER

both sides of (5) by D^2, the expression becomes as in Fig. 3, and we may cancel D^2 in numerator and denominator on the right-hand side, giving, when written in reverse order,

$$P = \frac{p \times d^2}{D^2} \qquad (6)$$

Then, putting in the values given by H. C., we can perform the operations indicated and get the value of P, the pump pressure. In doing the arithmetical work, it is advisable to reduce the mixed numbers to improper

$$\frac{p \times d^2}{D^2} = \frac{P \times D^2}{D^2}$$
$$P = \frac{p \times d^2}{D^2}$$
$$P = \frac{100 \times (1\frac{7}{8})^2}{(1\frac{9}{16})^2} = \frac{100 \times \frac{15}{8} \times \frac{15}{8}}{\frac{25}{16} \times \frac{25}{16}}$$
$$= 100 \times \frac{15}{8} \times \frac{15}{8} \times \frac{16}{25} \times \frac{16}{25}$$
$$= 144 \text{ LB.}$$

FIG. 3. TRANSFORMING THE EQUATION AND SOLVING THE PROBLEM

fractions, express the entire operation and cancel as much as possible, remembering that to divide by a fraction, either proper or improper we invert the divisor and multiply as shown in Fig. 3, giving the result 144 lb., or in other words the pump pressure should be 144 lb. per square inch to just balance the boiler pressure of 100 lb. per square inch acting on the valve disk.

In practice the pump pressure is carried considerably higher to insure an uninterrupted flow to the boiler. The pump pressure in this case should be not less than 150 lb. per square in., or even more.

H. C.'s method of figuring is in error; for example, he finds the areas from both diameters, subtracts one from the other, and divides by 100 lb. boiler pressure, and finds that the pump pressure should be 184 + lb., which is not correct.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

OPERATION OF STORAGE BATTERY

Abstract of Rules Issued by The Electric Storage Battery Co.

SPECIFIC gravity of the electrolyte falls while discharging and rises while charging. It therefore affords a convenient means of following, the operation of the battery. Proper operation is very necessary, as both overdischarging and excessive overcharging are injurious to the plates and if persisted in will shorten their life. The specific gravity of all cells in a battery on discharge and charge falls and rises together, so that a reading of the electrolyte of one cell, termed the "Pilot Cell," will indicate quite accurately the state of discharge or charge of the battery as a whole at the time the reading was taken.

Pilot Cell

FOR the pilot cell, select one cell and keep the level of the electrolyte at a fixed point (one-half inch above the plates) by adding a little water at frequent intervals. The proper height can be marked by a paint line on the outside of the jar.

Discharging

IN regular operation it is not advisable to allow the battery to discharge to the point where the lights become dim. A safe rule is not to allow the specific gravity of the pilot cell to fall more than 20 to 25 points belows the gravity reached on the last preceding overcharge. This does not necessarily mean that

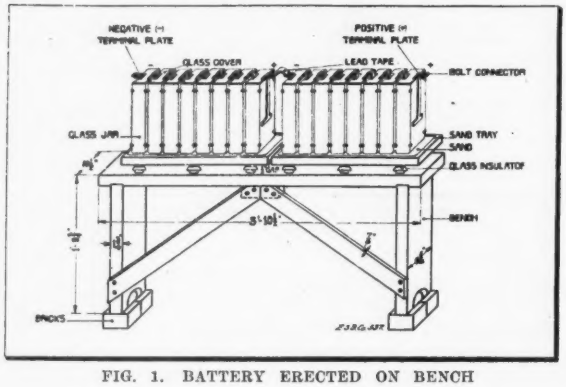


FIG. 1. BATTERY ERECTED ON BENCH

the full capacity of the battery has been used, but is a safe working range, allowing some reserve for emergency.

Charging

IN regular operation there are 2 kinds of charges to be given the battery, as follows:

The "regular charge," given as often as necessary in order to recharge the battery after discharge, and the "overcharge," to be given once every 2 weeks; this is merely a continuation of the "regular charge," and is given chiefly for the purpose of keeping the battery in good condition by equalizing any irregularities which may develop.

When to Charge

WHENEVER possible the battery should be charged at regular periods. A little experience will soon show how often charging is necessary to keep the lamps from burning dim and the specific gravity of the pilot cell from reaching the discharge limits given above. If the battery is partially discharged and

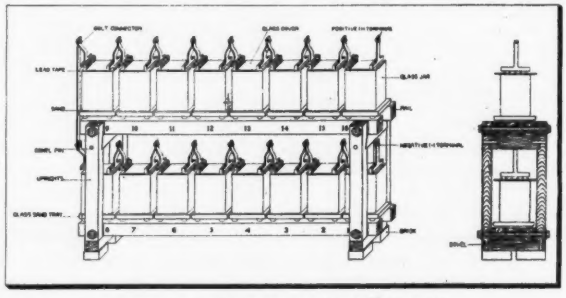


FIG. 2. BATTERY ON WOOD RACK

there is any doubt as to its being able to supply enough current until the next charging period, it is better to charge at once.

Regular Charge

CHARGE at the normal rate until the specific gravity of the pilot cell has reached a point which is about 3 to 5 points below the maximum reached on the pre-preceding overcharge. Thus, if the gravity reached on the last preceding overcharge is 1.209, the regular charge for the next 2 weeks should be cut off when the gravity has risen to about 1.204 to 1.206. The cells should all be gassing moderately at this time, that is, not quite so freely as on the overcharge.

If when the discharge limits are reached or approached and there is not time to complete the charge, then a partial charge may be given. Care should be taken, however, to complete the charge at the first opportunity.

Overcharge

ONCE every 2 weeks continue the regular charge until the specific gravity of the pilot cell shows no rise over a period of one hour and all cells have been gassing freely for the same length of time. Keep a record of this maximum reading of the pilot cell gravity to be used as a guide in stopping the regular charges for the following 2 weeks.

Replacing Evaporation

TO replace evaporation from the electrolyte, use only pure water; this should be added often enough to keep the plates covered; do not, however, fill the cells too full. Well, spring or river waters are often of sufficient purity. Rain water is often satisfactory if obtained in the open country on a clean slate or shingle covered roof and kept in a clean, covered non-metallic receptacle. Care should be taken to allow the rain to flush the roof before catching the water.

Cell Readings and Inspection

READ the specific gravity of each cell with the hydrometer at the end of the charge preceding the overcharge and record the readings in a blank book.

Carefully look over all cells just before the overcharge and make sure that there are no short circuits, either between the plates or hanging lugs. Pay particular attention to cells which gas slower than surrounding cells at the end of charge, and to cells which read lower than the others as shown by the cell readings. Any short circuits discovered must be removed at once.

Indications of Trouble

THE following are indications of trouble which may exist in the cells:

Falling off in specific gravity of a cell as compared with surrounding cells; lack or deficiency of gassing on regular charge or overcharge as compared with the rest of the cells; color of plate markedly lighter or darker than in surrounding cells. If any of the above symptoms are noted, inspect the cells in question at once for short circuits or impurities in the electrolyte.

Electrolyte

WHEN first installed the specific gravity of the electrolyte, with the battery fully charged, should be between 1.205 and 1.215. There is a gradual loss due to spraying, however, and when due to this cause the gravity at full charge has fallen to 1.190, communicate with the battery company as to the best procedure to follow.

Be careful not to allow any impurities, especially metals, to fall into the cells. If this has happened, the electrolyte should be renewed at once, thoroughly flushing the cells with water when making the change. When handling electrolyte never use metallic vessels. Glass or earthenware is suitable.

Sediment

THE accumulation of sediment in the bottom of the jars must be watched and not allowed to get up to the plates, for if this occurs, serious injury will result. To remove the sediment proceed as follows: Fully charge the battery, lift out the plates from one cell, draw off the electrolyte into a glass jar or earthenware vessel, wash out the sediment; replace the plates and fill with electrolyte as quickly as possible, so that there will be no chance of the plates or separators drying out. As there will be some loss, some new electrolyte of 1.210 specific gravity will be required to complete the filling of the cell. Then in the same manner clean the next cell and so on throughout the battery. If the gravity is low, it should be restored to standard 1.205 to 1.215 at full charge, by the addition of electrolyte instead of water to replace evaporation. When the work is completed, charge until all cells have been gassing freely for 10 hr.

If the battery is to be used at infrequent intervals, then a freshening charge should be given once every 2 weeks.

Putting Battery Out of Commission

IF the use of the battery is to be discontinued for a considerable time, and it is not possible to charge at least once every month, then it should be taken out of the service as follows: After thoroughly charging, siphon off the electrolyte, which may be used again, into thorougly cleaned glass receptacles, and as each cell becomes empty, immediately fill it with fresh, pure water. When water is in all the cells, allow the battery to stand 12 or 15 hr.; if wood separators are used remove and throw them away, and use new ones when the battery is put into service again. Next the water should be siphoned out of each cell, and the battery can then be allowed to stand indefinitely. If there is a considerable amount of sediment in the cells, it should be removed before it dries.

Putting Battery Into Commission Again

TO put into service again, fill cells with either new electrolyte of 1.210 specific gravity, or if the old electrolyte has been saved, add enough new of 1.210 specific gravity to replace loss. Charge for 35 hr. at the normal rate, or for a proportionately longer time at a lower rate. If the gravity after the first charge is low, it should be restored to standard.

PROPER HEIGHT OF LAMPS

The Effect of Height of Suspension of Lamps Upon the Intensity of Illumination

By W. E. Barrows, Jr.

THE fact that the intensity of illumination due to a point source of light varies inversely as the square of the distance between the source of light and the surface illuminated is familiar to all, but the significance and the practical application of the relationship existing between the distance from an infinite linear source or an infinite surface source and the intensity of illumination resulting therefrom are realized only by those most vitally interested in or intimately associated with the theory or uses of light.

It has been demonstrated by numerous investigators, and it can be shown mathematically, that the illumination at a given point in a normal plane due to a tubular source of infinite length varies inversely as the distance from the source to the point illuminated and not inversely as the square of the distance, as in the case of a point source. It is also well established that the illumination at a point on a normal plane due to an infinite surface source is quite independent of the distance between the point and the source.

It is obvious that luminous sources having infinite dimensions are merely theoretical, but it is interesting to assume certain practical conditions and learn how approximately the infinite dimension relationship may apply in practice. For this purpose the writer has chosen the 100-watt tungsten unit equipped with the intensive type of high-efficiency reflector. This type of reflector is so designed that when it is used with the proper lamp and the units are properly placed approximately uniform illumination on the working plane will be obtained.

The distribution of light in a vertical plane through the axis of this type of lighting equipment is shown in

Fig. 1. This polar candle-power curve shows only the intensity of the light in different directions in a vertical plane and gives no clew as to the resulting illumination. The illumination due to one lamp placed 8 ft. above the reference plane is indicated by curve a of Fig. 2. If 2 lamps are placed 10 ft. apart and 8 ft. above the plane, the illumination along a line beneath the 2 lamps will be approximately uniform, as indicated by curve b of Fig. 2. With a distance of 10 ft. between lamps, 8 ft. is the minimum height of sus-

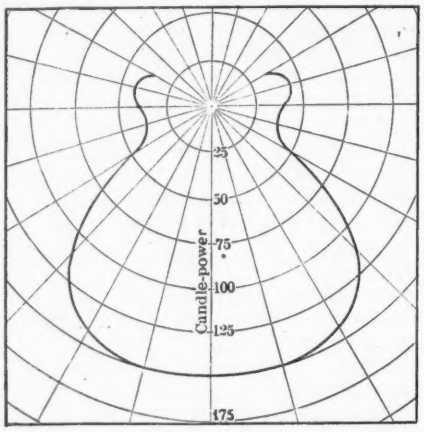


FIG. 1. INTENSIVE TYPE OF POLAR CANDLE-POWER CURVE

pension which will secure approximately uniform illumination. The 2 lamps can be placed at greater heights with the same spacing without impairing the uniformity of illumination, although the intensity of illumination will be lower.

To investigate the effect of the height of suspension of lamps above the plane illuminated the writer has assumed a room 50 ft. by 50 ft. in area and lighted by the equipment just described. The lamps are placed, according to common practice, at centers of equal areas, each 10 ft. square in this case, as shown in Fig. 3. The reflections from walls and ceiling are neglected, and the results are calculated from the polar candle-power curve of Fig. 1 by the point-by-point method.

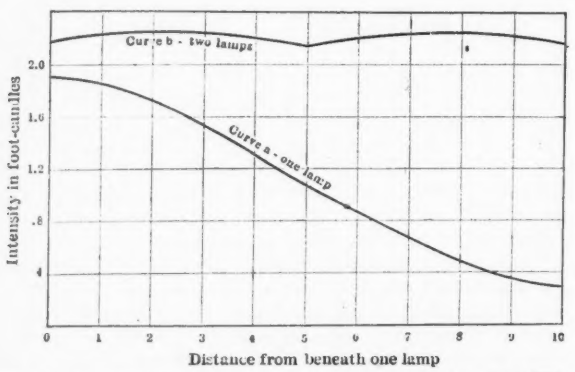


FIG. 2. ILLUMINATION DUE TO ONE AND TWO LAMPS PLACED 8 FT. ABOVE THE PLANE ILLUMINATED

The illumination at the center on the room was determined for 3 conditions: First, due to one lamp (No. 13) which may be considered a point source; second, due to a row of lamps (11 to 15, inclusive), and, third, due to all of the 25 lamps.

The results thus calculated with the lamps at different heights are represented graphically in Fig. 4, together with those for the theoretical infinite linear and surface sources. The minimum height is 8 ft., the least height permissible for uniform illumination with a spacing of 10 ft. between the particular lighting units selected. The uniformity of illumination is approximately the same for all heights from 8 to 20 ft. In

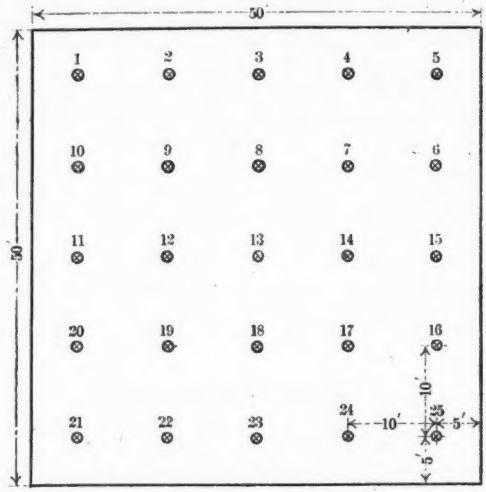


FIG. 3. LOCATION OF LAMPS IN ROOM

Fig. 4 the illumination is expressed in per cent of that at a height of 8 ft. Curve a simply represents the case of one lamp or a point source; the illumination varies in accordance with the inverse square law. Curve b indicates the variation in intensity due to the row of five lamps, showing a considerable departure from the inverse square law but not a very great difference from the theoretical infinite tubular source represented by curve c, which is plotted with illumination varying inversely as the height of suspension. Curve d represents the intensities due to the 25 lamps

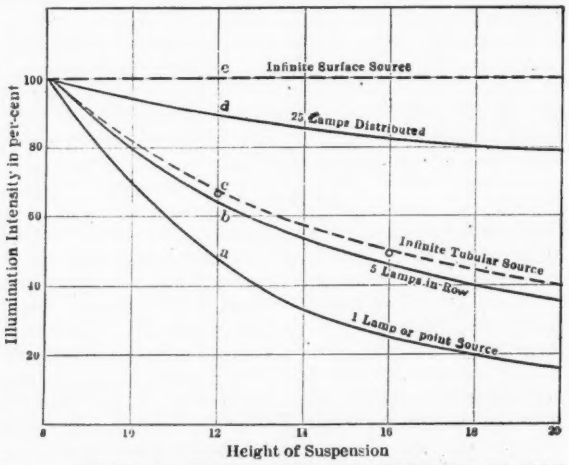


FIG. 4. EFFECT OF HEIGHT UPON THE INTENSITY OF ILLUMINATION AT CENTER OF ROOM

and curve e the ideal case of an infinite surface source.

In interpreting these results it must be borne in mind that the lamps have been raised from 8 ft. to 20 ft., or through a distance of 12 ft., and no correction has been made for reflection from walls and ceiling.

These curves thus represent the maximum decrease that may be expected even with dark walls and ceiling. The decrease in intensity of illumination when the lamps are uniformly distributed and are raised to a greater height is obviously due to a greater part of the light passing to the walls and ceiling. If the walls and ceiling are white in color, about 70 per cent of the light thus apparently lost will be returned to the reference plane and will greatly reduce the difference between curves d and e. The same line of reasoning will apply to some extent to the other cases as well. Moreover, a little thought will make it clear that as the lamps are raised the rays passing to the walls and ceiling strike those surfaces at angles which are more effective in throwing this light on to the working plane.

This article was prompted by the feeling that many mistakes are continually being made in the lighting of large rooms by locating the lamps too low. There appears to be an insistence among those "who know not, but think they know," that the proper heights at which to locate the lamps of an installation is between 10 and 12 ft. above the floor, irrespective of the size of the room, height of ceiling, class of service or condition of the surroundings. In a large room with the lamps placed at this height the sources of light are only a little above the line of vision and shine into the eyes of the individual observing objects around the room. In this way the pupil of the eye is contracted and the illumination is less effective and less satisfactory than when lamps are placed higher and out of the range of vision, although the intensity may be several per cent less.—Electrical World.

EXPERIENCES IN A POWER PLANT

By L. N. Bexton

EXPERIENCES related by R. A. Cultra in the Aug. 15 issue of Practical Engineer are by no means extraordinary. I began work as switchboard operator in a power company's substation where the equipment included 2 motor-generator sets of 500 and 100 kw. capacity respectively. The motors operated on a 9000-volt, 25-cycle circuit and the generators delivered 2300-volt 60-cycle current.

We had a commercial and an arc load; the distribution was 3-phase 4-wire. The groaning mentioned in Mr. Cultra's article occurred quite frequently, yet it always had a hair-raising effect.

One night a wrecker tore down all 4 wires of one circuit; there was an unearthly groan and the lights dimmed, then the overload relay released the circuit and the machine settled down. I closed the switch and the groaning was repeated. The sound really is indescribable and to be appreciated must be heard, especially in the small hours of the morning.

After a fire in the arc switchboard room, the board had been overhauled and put in apparently first-class condition. Everything was running smoothly, the Tirrel regulator was holding the voltage steadily and I was interested in a technical magazine when the lights flickered and that awful groan sounded.

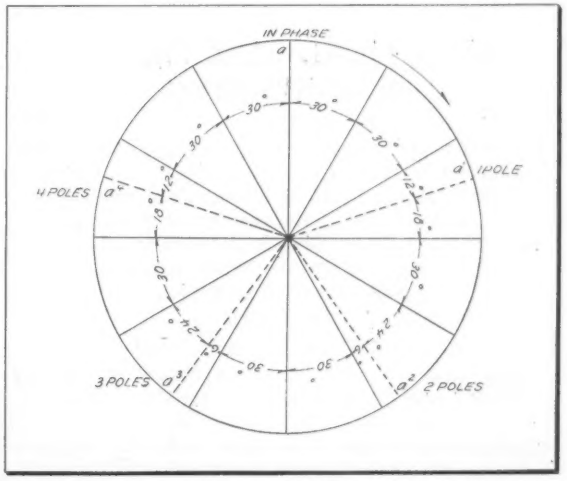
Going to the board I saw a green light on the arc pilot lamp and found a fuse blown; we used enclosed fuses. I drew the plugs and as we kept spare receptacles ready fused, I put one in place and plugged in. There was no circuit, so I removed one primary plug and fused the other side. During these operations quite an audience had gathered. As I pushed the fuse into place it exploded like a shot gun; we all jumped and I removed all the plugs and re-fused one side.

We were laughing and talking and several seconds had passed when both fuses exploded nearly simultaneously. Then the spectators drifted. There was a "dead short" through the fibre plate supporting the primary terminals.

Synchronizing

TROUBLE in synchronizing experienced by I. M. Coming reminds me of a somewhat similar case. We had 2 units of 500 kw. and 1000 kw. capacity. No. 2, the larger machine, was used during peak load. One night we were called on to carry an additional load which was usually carried by another station, which reported the size of the load as shown by its ammeters and the operator in charge thought No. 2 could carry it. After getting it, however, the machine was overloaded.

Both machines were motor driven by synchronous motors; the motor ends were synchronized and then the generator ends were tested for polarity. There were several positions where the motors were in step,



DIAGRAMMATIC RELATIONS OF POLES IN MOTOR-GENERATOR SETS

but only one where both motors and generators were in step. The synchroscope was calibrated to indicate the number of poles difference in position and the correct position was obtained by opening the motor switch and letting it slow down so that the next pair of poles would be in synchronism.

The meter indicated machines in step, but when thrown together the big machine's load increased and both machines groaned. No. 1 was disconnected and again tested for synchronism; the needle did not point to exact synchronism, but indicated a slight lead for No. 1. The load was so arranged that it could be carried on either of 2 buses which were normally connected. I got part of the load on bus No. 1 and part on bus No. 2. Then I disconnected the buses and threw machine No. 1 on bus No. 1. I plugged in the 2 buses on the synchroscope and found them in step, so I closed the connecting switch and the machines divided the load without further trouble.

My explanation of the trouble was that No. 2, being overloaded, lagged behind No. 1 several degrees, so that when thrown together the motors assumed a position of synchronism which placed the

generators out of step. By dividing the load this lag was equalized and they could be thrown together.

There was another singular occurrence when the generators were thrown together out of step one pole; the smaller machine "kicked off" after somewhat ot a demonstration. Another time they were thrown together 2 poles out of step. They held together, but there were heavy cross currents. I concluded that, although further out of step in mechanical degrees, they were nearer in step in electrical degrees. The motors had 10 poles and the generators 24 poles. On the generator a pole covered 15 deg. and on the motor 36 deg., hence 360 electrical degrees on the generator equaled 30 and on the motor 72 mechanical degrees. There were 5 positions of synchronism for the motors.

With 4 poles to slip, to synchronize the generators would be out of step 12 deg. mechanically, at 3 poles they would be 6 deg. out of step mechanically, at 2 poles they would be 6 deg. out, at one pole 12 deg. out. This is clearly shown by the diagram, which represents the one generator with full lines and the various positions of the phase pole of the other generator by dotted lines. By phase pole is meant the pole which will be in step with "A" when both generators and both motors are in step.

PRACTICAL ELECTRICAL ENGINEERING

Lines of Force About a Conductor and Their Effect Upon the Lines Between 2 Magnetic Poles. The Generator and Motor and How the Directions of the Lines of Force, Current, and Motion are Determined by Fleming's Rules. Simple Loop Revolving in a Magnetic Field and How Current is Generated

IN A PREVIOUS article, the setting up of magnetic lines of force about a conductor carrying current was discussed. The relation of these lines to the lines passing from a north to a south magnetic pole is one of the most important phenom-

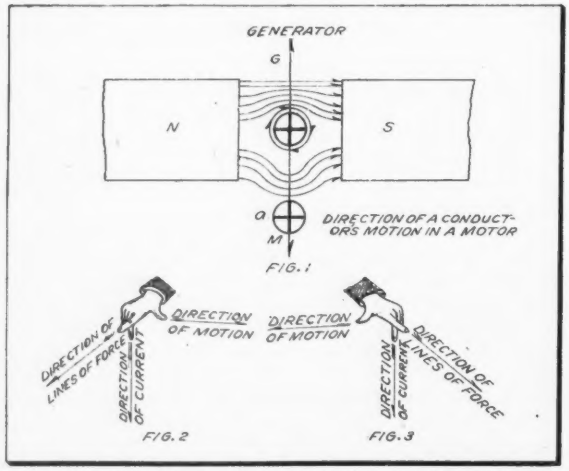


FIG. 1. BEHAVIOR OF A CONDUCTOR IN A MAGNETIC FIELD
FIG. 2. FLEMING'S RULE APPLIED TO A GENERATOR
FIG. 3. FLEMING'S RULE APPLIED TO A MOTOR

enons to understand and remember, because upon the reaction between the 2 depends the principle of operation of generators and motors.

In Fig. 1 assume that current in the conductor, represented by the circle, is flowing away from observer. Under these conditions the magnetic flow of the lines will assume a direction corresponding to motion of the hands of a clock. The conductor lines oppose those of the magnetic field below the conductor but coincide with the lines above the conductor which,

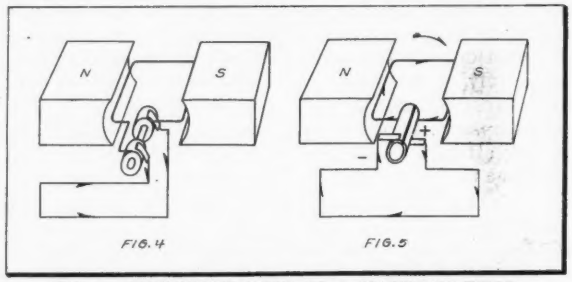


FIG. 4. REVOLVING LOOP IN A MAGNETIC FIELD
FIG. 5. REVOLVING LOOP PROVIDED WITH COMMUTATOR

if it were free to move, would take a direction indicated by the arrow M pointing downward which illustrates the action of a motor. If the conductor was forced by mechanical power in the direction indicated by the arrow G, pointing upward, current would be generated in the conductor.

To illustrate this action more fully we will assume for the sake of illustration that the lines from N to S are rubber bands. If the conductor were in the position indicated at a and were forcibly pushed upward, the bands would be stretched and work would

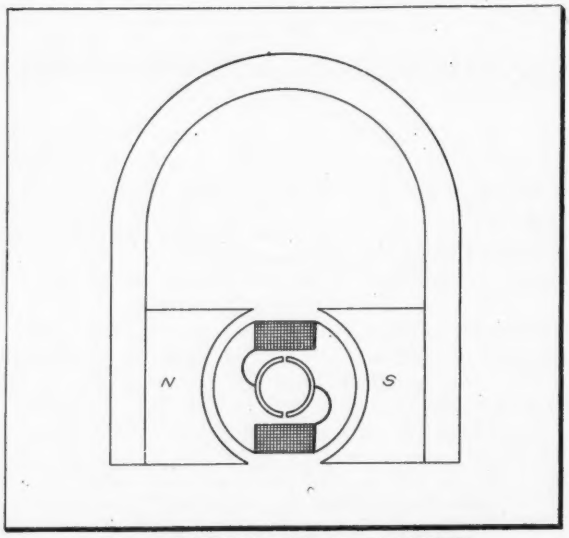


FIG. 6. MAGNETO-ELECTRIC GENERATOR

have to be done to overcome the resistance of the bands. If the conductor was released it would be violently repelled by the rubber bands and be forced in the opposite direction.

There are 2 simple rules known as Fleming's rules, for determining the relative directions of the lines of force, current and motion in a generator and motor. For a generator; Place the thumb, forefinger and middle finger of the right hand each at right-angles to the other 2 as shown in Fig. 2. If the forefinger shows the direction of the lines of force and the thumb shows the direction of the motion of a conductor, the middle finger will show direction of the induced current.

For determining the direction of the 3 factors in a motor, arrange the thumb and fingers of the left hand in a similar manner to that used with the right hand, as shown in Fig. 3. If the forefinger shows the direction of the lines of force and the middle finger shows the direction of the current, then the thumb will indicate the direction of motion given to the conductor.

If a loop of wire connected to 2 contact pieces be revolved between north and south magnetic poles, and the contact pieces are connected to an outside circuit, an electromotive force (e.m.f.), will be generated and current will flow through the loop and the external circuit. This current will, however, flow first in one direction and then in the opposite direction as the respective sides of the loop pass the N and then the S pole, the direction of the current in each instance being determined by applying Fleming's rule.

If we replace the 2 contacts of collector rings, connected to the loop of wire, with a split cylinder with one half insulated from the other as shown in Fig. 5, current will flow through the external circuit continuously in one direction and is known as direct current. The split collar is commercially named a commutator and its function is to receive the current from each side of the loop as it rotates past the poles thus maintaining a unidirectional flow.

In generators and motors as built for commercial purposes, there are a great many loops of wire surrounding an iron core which is built up of sheet iron disks. Instead of a simple split cylinder the commutator is built up of segments to which the ends of the loops or coils are connected. Fig. 6 shows the simplest form of dynamo or magneto generator which consists of a slotted cylinder of iron on which is wound a large number of turns of wire, the 2 ends being connected to a 2 piece commutator. This cylinder revolves in a magnetic field composed of a permanent horseshoe magnet and soft iron poles N and S.

A SOCIAL CHAT

Exchange of Confidences Between the Engineer and Fireman; the Slide Rule Versus a Piece of Slate; Babbitting Boxes

By N. W. Duell

ENGINEER of the Notorious Mfg. Co. went into the fire-room one day to show his new slide rule to Nibbs the fireman. "Where did you get that," says Nibbs. "I saw it demonstrated in Practical Engineer and concluded it must be alright so I got one." "Well let's see you figure the allowable pressure on that 48 in. by 12 ft. boiler," at the same time picking a chunk of slate out of the coal pile and using a small piece for a pencil, he starting to figure.

"Well alright then here goes—it has 5/16-in. plates single riveted lap joint," and making a few moves on his rule the engineer said "89 lb. and deduct 5 lb. for depreciation, ain't it dangerous to carry 100 lb. on it?"

"We don't carry 100 lb. on it though."

"How do you know?"

"How do I know? Simply because I've got an indicator and by attaching it to a steam connection and drawing both the atmospheric line and steam line while the safety valve was blowing and measuring with the spring scale then comparing it with the gage I found the safety valve popped at 85 lb. while the gage showed 100, so I left it that way. If we had a state boiler inspection law here in Washington, as we should have, that boiler and dozens of others would be side tracked and good butt joint boilers would be put in."

"But that ain't as bad as a gage I know of in a shingle mill; the gage showed 97 lb. and the safety valve was set at 110 lb."

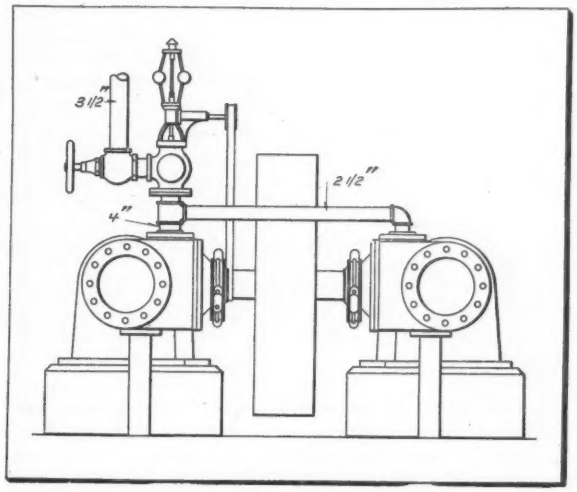
"Shingle mill? By Hokey, I wouldn't monkey round some of them places for love nor money."

"Me neither, I would join the ranks of the soap box orators down on Washington Street first; some of those engineers have to fire the boilers, look after the engines, pumps, conveyors, and do the oiling of the mill, and as to firing, it isn't firing, but just burning up waste material, and the more he can burn the better man he is, and they only get about $2 and 6 bits a day, and a man can work around one of those places 10 yr. and never be any better off."

While the engineer was talking he was making a sketch on a board.

"Here is the way I saw a twin engine piped up in a shingle mill one time."

The fireman spoke up and says "I was reading an article in Practical Engineer on how to babbitt a quarter box, it said to take the shells out and set them



INCORRECT STEAM CONNECTION IN A SHINGLE MILL

on end and use a short mandrel a little smaller than the shaft, then, after pouring the metal, bore them out, what would you do here? You haven't got any machine shop to bore them in."

"Well to begin with, we would take out the shells, put a sheet of smooth oiled paper around the shaft, level the shaft, also aline it, then set a piece of sheet iron in on each side of the shaft to shoot the babbitt into the shell, melt the babbitt in 2 ladles, and after cleaning drop in a chunk of rosin big as the end of my thumb and pour in both sides, take out the shell again and dress it up and trim off the corners at end of box, for there is a great source of trouble with hot boxes; after replacing set in the stationary shell, make sure the shaft is square with center line of engine, and pour the metal, trim as before, and proceed with moveable shell same as the other. After trimming the corners off cut oil channels and replace, put on cap, key up, even up the cylinder clearance, start your engine up slow using plenty of oil and keep it keyed up close. Let it wear to a bearing, but don't let it get too hot.

"The rosin will make the metal run like water to every little corner, and don't forget to set your valve after you get done, or better, put on the indicator."

CALCULATING STEAM CONSUMPTION

Figuring from the Indicator Diagram to get Clearance, and Steam Used by the Engine

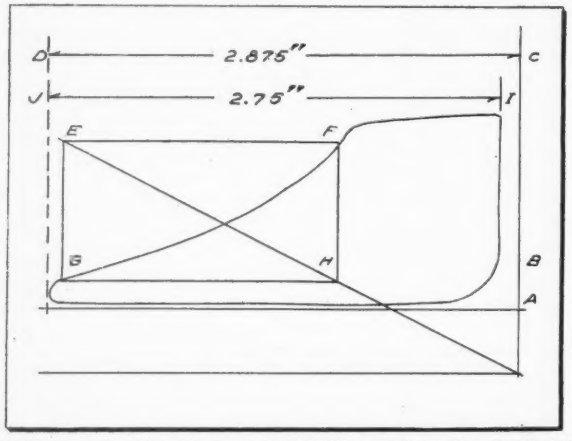
By Calvin F. Swingle

IN order to calculate the steam consumption per i.h.p. per hour, it is necessary to know, (a) the absolute terminal pressure; (b) the volume or piston displacement in cubic feet; (c) the volume of clearance space in cubic feet; (d) weight of steam saved by compression, as shown by the compression curve in the diagram. To find (a); select a point in the expansion curve just previous to the opening of the exhaust valve and, with the scale adapted to the spring used in taking the diagram, measure the pressure from the atmospheric line to this point, to which add 15 lb. for absolute pressure.

To find (b); multiply area of piston in square inches by length of stroke in inches; the product will be piston displacement in cubic inches, which divide by 1728 for cubic feet.

Getting Approximate Clearance

THE theoretical value of (c) may be ascertained from the indicator diagram by the method shown in the illustration, provided the expansion curve assumes an approximately correct form.



METHOD OF MAKING MEASUREMENTS FROM THE DIAGRAM

In the cut shown, the measurements are made from the expansion curve. Two points, F and G, in the curve are to be located as far apart as possible, and yet each must be within the limits of the expansion curve, as for instance, F is located just after cutoff occurs, and G is at a point before release begins. From F draw a line F E parallel with the atmospheric line. From G draw line E G, and from F draw line F H, both lines to be perpendicular to the atmospheric line. Then from G draw line G H, forming a rectangle, F E G H having 2 opposite corners, G and F, on the curve.

Through the corners, E and H, draw the diagonal line E H, extending it downwards until it intersects the vacuum line, which is 15 lb. below atmospheric. From this point the vertical line B C, which is the theoretical clearance line.

To calculate the clearance in per cent, proceed as follows: Measure the distance from point I to point J, which in the illustration is 2¾ in., or expressed decimally, 2.75 in. This represents piston displacement. Next, measure the distance between points C and D, which is 2⅞ or 2.875 in., representing piston displacement with volume of clearance added. Then, $2.875 - 2.75 = 0.125$, which represents volume of clearance, and $0.125 \div 2.75 = 0.045$ or 4.5 per cent clearance. The term, clearance, in this connection, implies not only the piston clearance but the entire volume of space between the piston when at the end of the stroke, and the valve face. It usually ranges from 3 to 5 per cent of the piston displacement.

The value of (d) depends upon the amount of compression as indicated by the diagram, and it is an important factor in calculations for steam consumption. If an engine had no compression its steam consumption per horsepower per hour would be greatly increased above what it should be, for the reason that the steam required to fill the clearance space at each stroke of the piston is practically wasted, and all of it passes into the atmosphere, or into the condenser as the case may be, without having done any useful work, except merely to fill the space devoted to clearance. This fact emphasizes the importance of adjusting the exhaust closure so as to have it occur neither too late, nor too early, but at that particular moment before the piston shall complete the return stroke that will cause such compression of the steam still remaining in the cylinder as to give the best results as a cushion for the piston. This point can only be determined correctly by the use of the indicator.

Figuring the Steam

STEAM consumption is ascertained as shown by the following calculation: Assume the cylinder to be 16 in. bore by 42 in. stroke; then, piston displacement will equal area of piston (201.06 sq. in.) × length of stroke (42 in.) = 8444.52 cu. in.

Assume a clearance of 4 per cent. Then volume of clearance equals $8444.52 \times 0.04 = 337.78$ cu. in. When there is little or no compression, this must be added to piston displacement thus, $8444.52 + 337.78 = 8782.3$ cu. in., which divided by $1728 = 5.08$ cu. ft. as the volume of steam exhausted at each stroke of the piston. Assume an absolute terminal pressure of 20 lb. The weight of 1 cu. ft. of steam at this pressure = 0.0507 lb. The total weight of steam exhausted at each stroke will therefore $= 0.0507 \times 5.08 = 0.2575$ lb. Assume the engine to make 140 working strokes a minute, then the weight of steam consumed per hour will be: $0.2575 \times 140 \times 60 = 2163$ lb.; which divided by the horsepower developed will give the number of pounds weight of steam per horsepower per hour. For instance, assume the engine to have been developing 100 hp.; then its steam consumption equals $2163 \div 100 = 21.63$ lb. per hp. hr.

Although the volume of clearance may in many cases be determined from the indicator diagram by the method shown in the illustration, a still more practical and reliable method is to place the engine on the dead center, close the cylinder cock on that end, and having removed the valve, fill the clearance space with water to a level with the valve seat. Account should be taken of the number of pounds water required to fill the space, and with this data the number of cubic inches or cubic feet of clearance can be accurately computed.

A process of waterproofing Portland cements (U. S. Pat. No. 1,029,643), consists is smearing a fatty acid amide, together with a finely devided mineral "carrier" therefor. Aluminum silicate is used as the carrier.—Mining and Engineering World.

CORRESPONDENCE OF AN OLD ENGINEER AND HIS SON

Transferred from Boiler Room to Repair Shop—How Crissy Had to Start at the Bottom

MY DEAR FATHER:

It is always a great treat to receive a letter from you, as it contains so many things that set me thinking and help me to surmount the many difficulties that are continually coming up.

I read your last letter over several times and believe that I can not only repeat those beautiful lines from the poem from memory, but also the sum and substance of the entire letter. As I sit there before the boilers when the load is a little lighter for the time being, and not so heavy but that I can have a little breathing spell, sketches of your letters pass in review before me as a beautiful panorama.

I do not pretend to retain in my memory all of your several letters, but somehow or other, every time something happens, some little piece of advice from some of your letters is brought to mind which applies to the case in hand, and it helps a great deal.

I think that you will admit that I was not such a bad sort of a boy back on the farm at Sussex. True, I had my "days of deviltry," the same as all the rest of the boys in the world have, but I want to say one thing right here, father, and that is, that I see now where I did not fully appreciate your best efforts in my behalf then when I had a chance to. So I am going to try to make amends for my former shortcomings by trying to absorb all of the advice that you write me and stow it away in the recesses of my memory for future reference.

I fully realize now that "it is up to me." You paid out quite a sum of money for my education and while I did not actually learn any one thing or series of things at "Tech.," I assimilated a sort of guide book, or directory, which will make it easier to grasp the difficult matters which one meets in daily life as they come up.

Of course it is true that we did a lot of mechanical experimenting at the Institute, but while I have never yet found a parallel case to anything we ever did there, yet the things that we did do there make it so much easier to do the things here.

We ran tests of every thing that there was in the laboratory and I was foolish enough to think that when I started to work, that I would find a great deal of testing to do. I find, however, that most of the testing is the testing of one's ingenuity. Now, there was Prof. K. G. Smith, who delivered a 2 hour lecture on the "Philosophy of Pipe Cutting," one day.

Prof. had each one cut off a little piece of pipe with the pipe-cutter and thread it, and then he would elucidate at length on pitch, angles, dies, taps, merits and demerits of, cast and malleable fittings, steel and iron pipe and all that sort of thing, but when he got done, we didn't know any more about it than when we started.

Now, I'll tell you what I think is the reason why so many students from technical schools fail to make good when they do get out and settle in a position; back at school when they are doing all these different things, there seems to be no purpose in view. When the boys have all threaded their little piece of pipe, it is all thrown into the scrap and that is the end of it. They go to the lathe and bore out a little piece of cast iron and turn a plug to slip into it a running fit and after amusing themselves for a few hours holding their hand over the top so that the vacuum will keep the plug from falling out, the novelty soon wears off. Such tasks soon become irksome.

But as soon as one is settled on a job, how things change! Sometimes at nights there is a little job to do at the plant and as a usual thing, the Chief asks me to come back and help him. When you rip out several feet of intricate piping which has been put in temporarily while some other thing was being changed, and cut threads, maybe 2 to 3 in. at that, make up connections, flanges, tees, or perhaps a right-and-left elbow, then there is an apparent reason for cutting threads, for when the steam or water is turned on, (as the case may be), things actually take place and the interest in the job is sustained, whereas back at "Tech." interest in the job was lost as soon as we were dismissed from the class.

I really think that some of the boys fall down on a real job simply because they come to believe that everything is an experiment when they get on the payroll of some company and they seem to loose sight of the objective point.

The Chief asked me one day if I thought that I could put a brass sleeve on a pair of pump rods which had become fluted pretty badly, and I thought that I could. So on Saturday afternoon when the shop was shut down, I got the coal passer, (the same that I used to be) to fire the one boiler for me and I took the rods out of the pump, turned them down, to size and pressed a piece of brass tubing the same size as the rod, over the rod where it was turned down, and when I got it all done and the pump working again like a new one, there was a sense of great pride came over me that never was present at "Tech." when we formed our stereotyped little cast-iron toys for the "Prof.," the same as boys had done for the preceding 20 years.

Doing actual work, and making believe, are two entirely separate things and I know of several of the boys who actually got to believe that everything was make believe, and when they found out that this was a very real world, it nearly broke them all up trying to remodel the world to suit them.

There was Crissy Montgomery, for instance. Crissy played short in the "nine," stroke oar on the "crew," and center on the "squad," and, being a good man at all of these things, was quite a factor in maintaining the standing and dignity of the Bergville Technical Institute. It was sort of tacitly understood among the professors that he was to be graduated, and that was all there was to it. So when we had our final "exams," he found that his father's controlling interest in The Rowley, Davis & Montgomery Co., was an important factor in securing high honors and he berated himself for having unnecessarily worked so hard during the past 4 years.

Crissy came to look on life as one huge joke. He first tried the engine business in all its phases, with the Siegel & Hooper Co., and as soon as the novelty of moulding or making cores wore off, he would loaf around till some one took notice and gave him a different job. It was proposed to "let him out," but his father was a very powerful man in a business way, and Crissy was given another job, until he came to think that life was one long sweet dream. Finally he did quit, because he got tired of the whole business. There was no apparent object in working, so long as

his father had lots of money, for he got an allowance of something like $150 a month anyway, and there was no incentive to "dig."

He was attracted by the auto business and ran the course in a brief 7 months and moved on to another, for there was something about roaming around the country in an auto that fascinated him,—for a time—but even the novelty of that wore off,—and he quit.

Three weeks ago I received a letter from him and, father, it made my heart ache to read it. It seems that his father became very careless in his prosperity and believing that he had ample funds, invested heavily in wheat. But wheat went down, and it took every penny to cover his margins. The market was steady for a few weeks and he believed that he could weather the gale.

Next day wheat slumped again, and he was down and out, except for a farm and some city lots which his wife owned. So Crissy, thus rudely brought to his senses, fully realized that he now had to get out and hustle for himself, and he asked me for advice. I sent him that letter which you sent me when I left "Tech." and yesterday I received a reply from him, brief and to the point. All he said was "Digging holes for trolley poles on the new C. & M. Electric Line, and singing baritone in the Baptist Church, Sundays."

So Crissy found out when it was too late that when he took a 4 years course at "Tech." that he missed something. Well, he was always a very careful boy in regard to his health and being a pretty good athlete, anyway, with a peck measure full of medals to his credit, I guess that an apprenticeship on the business end of a "lineman's spoon" will not break his back.

But to digress a little. It is now some little time since I began to manipulate a No. 5 scoop for the Daneville Mfg. Co., and while I do not know all that there is to be learned at the intricate and interesting business of firing boilers, yet I have made quite a study of it and believe that I have at least mastered the rudiments of the process.

So when the Chief came to me a few days ago and asked me if I thought that I would like to make a change and go on the repair gang, I gave the matter my serious thought over night and concluded to take up with his suggestion. So they got another fireman who is a fireman. His name is Ed. Wilson, and he can make a red ring on the recording gage that looks as if it were drawn by a machine.

The wheelbarrow proposition where I got my start, is now intrusted to a young fellow named Jimmy Deutscher and he is getting away with it. So here I am, doing all kinds of repairing. This gang fixes everything that needs fixing, or that can be fixed. If we can't fix it, we fix it so that no one else can fix it.

We do all the electrical work, all the millwrighting, construction work, steam fitting, belt fixing, and in fact, everything around the place except the actual process of manufacture. It gives one a chance to exercise his ingenuity, as there are no 2 jobs that require the same treatment.

As I am a new man on the job, I have been more or less confined so far to holding down one end of a crowbar, or else moving the earth with a good grip on the end of a 4-ft. chain tong. I was also sent after the elusive left-handed monkey-wrench, but when I showed the gang the left-handed thread on the end of the handle, they thought that I was a boomerang, sure.

Now about the Chief's daughter, and I am done. Of course, your remarks on "picking out the right girl," were very good but I do not think that I will do any picking out yet till my wages become a salary and there are 3 figures on the monthly envelope. Still it is nice to know how to select a girl just the same as an engine or a pump.

Thursday evening I went over there to spend the evening, sort of unannounced, and she was doing the mending; and let me say, father, she seemed to be darning the Chief's sox every bit as good as mother does yours, and that is saying a good deal, isn't it?

Those sox that mother sent me arrived all right and are a good fit. Home made sox seem to last so much longer than the boughten ones. Well father, I am tired tonight and as it is now nearly ten o'clock, I must close and retire. Give my love to mother and remember me to all the neighbor boys that you happen to see. I see a brief notice in the Chicago Tribune that Jerry Smith, of Lisbon Co. is dead. Is that the Smith who used to be Coroner?

Affectionately your son,
Donald C. MacDougal.

GREASE LUBRICATION STANDARD

By G. A. Perley*

STANDARDIZATION is the keynote of industrial life today as substitution and adulteration were that of yesterday. The progress of the world is evidenced by the tendency to eliminate rule of thumb methods in every line. Public policy demanded standards and our present pure food laws show the result. Not only does public sentiment seek standards, but the private policy of standards is shown clearly successful in the operation of the Penn. Railroad specifications and standards, the Packard Auto specifications and countless others.

Still there are many cases where progress lags—adulteration and substitution still prevail. Unfortunately greases are one of the chief leaders in this class. The designer, manufacturer, agent, repairer and in fact every corporation whether individual or governmental have failed utterly in expressing as well as accepting the quality of grease lubricants required in their work.

The tremendous evil of grease substitution at our present time demands that the consumers as well as manufacturers protect themselves. In spite of the most essential importance of a perfect grease lubricant scores upon scores of people continue to ruin their machines, waste their money on a huge coal pile and curse greases as a whole, simply because either they have been foiled by a substitute sold with the usual words "just as good," or because they attempt to obtain dollars worth of material for a mere penny.

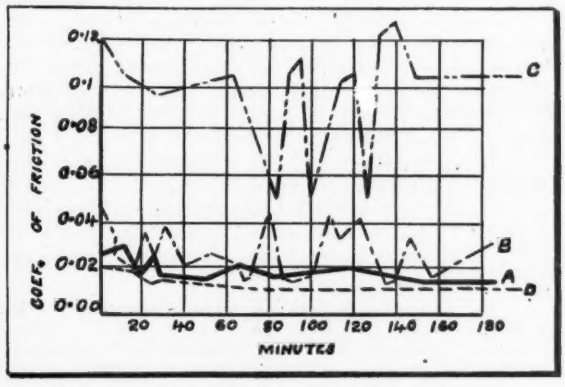
What methods may then be adapted by both parties in order to place grease lubricants on a firm basis? The literature is crowded with statements to the effect that chemical tests are meaningless to the practical man. In spite of all this the writer is a firm believer that the correct chemical and friction tests expressed in a clear manner are the most valuable asset to the consumer of grease lubricants.

When our present pure food laws went into effect —and even at the present time—how extensive a knowledge of the prescribed chemical tests did the

*Laboratories of the Albany Lubricating Co.

daily consumer of bread retain? Nevertheless the control that established definite food products has protected many a person from those pleasing fits of indigestion. No one can contradict the good derived from our pure food regulation. If some engineering society would adapt measures for grease lubricants analagous to the pure food laws the consumers protection would then be assured. Pure grease lubrication is as important to the machine as sanitary food is to each individual.

All are too familiar with the facts that good lubrication involves the prevention of injury, overheating or excessive overwear. Every consumer knows that the grease must have body in order to retain its position, but still there must be sufficient fluidity at the proper moment to do the essential work of a lubricant; it must be a conductor of heat in order to care for the heat generated by the friction of the bearings; it must not cause corrosion of the bearings; above all the chief object should be to separate the contact surfaces with such an efficiency that friction is practically eradicated. The layman is familiar with these grease requisites. Some definite source of standards will then enable the engineer to choose a proper grease provided these standards are backed by a responsible engineering society.



COMPARATIVE FRICTION TESTS ON GREASES

The analysis of lubricating greases is certainly complicated and the practical man becomes duly anxious over the true meaning of these expressions. To be sure analysis such as: "amount of mineral oil and hydrocarbon matter, per cent of unsaponified saponifiable material, amount and nature of soap, etc.," are chiefly of value to the lubricating chemist alone. These are necessary when compounding special greases, but the practical user should not bother with such tests. In spite of this the writer firmly believes that there are a few chemical and friction tests if placed under a rigid control would clear away confusion.

In suggesting the idea of standards, the writer realizes that it will not give the consumer the exact data as to the proper consistency of grease to employ for a specific machine. This can only be determined by trial. It will, however, protect the consumer to a far greater extent than ever before by the removal of greases, which corrode and ultimately increase the friction or cause uneven wear. If once the user realizes the requisites of a good grease he will be only too glad to experiment for the correct consistency, best adapted to the work. When that consistency is located the consumer knows that the grease will forever work in accordance with its class standard.

The writer has in view an outline of standards which will be published later, but the chief object of this paper is to incite the necessity of more rigid control of our grease lubricants by our reputable engineering societies. It is simply quality that is sought.

We will but briefly discuss the test that is undoubtedly the greatest guide in the choice of a good lubricant. The writer has the data on comparative friction tests of various lubricating greases, accordingly a practical example should bring the above suggestions to a fitting close.

Curve A is a representative curve of Albany Grease showing exceptionally constant low coefficient of friction over a wide range.

Curve B that of some other greases very variable due to separation of soap stock and oil, with the result that we have only spasmodic lubrication.

Curve C shows some materials—practically all soap—on our market unworthy of the name grease, yet sold as such.

For the sake of comparison Curve D gives the result of pure lard oil.

A simple glance at the chart tells the whole story in regard to the relative merits of the various lubricants at the particular pressure employed. Standards making it a requisite that curves for the friction tests as performed under the general control of some of our leading engineering societies should be accessible to all our engineers and would certainly mean a step towards protection.

UNIQUE CALCULATION OF TRAIN SPEED

By C. S. McGinnis

EVERYBODY of an inquiring turn of mind likes to know just how fast he is rushing through space on an express train, but most methods for figuring out this perplexing question are either too troublesome or too crude. Here is one that requires but a single bit of data to start with, and then a simple calculation to fill in the dragging moments.

Of course, what we wish to know is the speed of the train in miles per hour. Now the one thing we must know is the length of the rail; for convenience call this 30 ft. In most railroads one can hear the click as the train passes the junction between 2 rails, and so can count the number of rails passed over. The problem is, then, to express the speed in rails per unit time instead of rails per hour. Dividing 5280 (feet in a mile) by 30 (length of rail), we get 176, and so the unit of length has been reduced to 1/176 of its former value. Now, in order to keep the miles per hour numerically, the same as the rails per unit time, the unit of time employed must also be reduced to 1/176 of its former value. Since there are 3600 seconds in an hour, we have as our new unit of time $3600 \div 176$ or 20.4 seconds. This solves the problem and all we have to do is to count the clicks of the rails for 20.4 seconds, which at once gives us the speed in miles per hour.

Then, too, it is an old pastime to count telegraph poles. Generally after the counting, further calculation abruptly ends and a good guess follows. But we can work the problem as well by counting telegraph poles as rails, once knowing the distance between the poles. Call this distance 200 ft.—then 5280 divided by 200 is 26.4. Likewise we have 3600 divided by 26.4 or 136 seconds. If we count telegraph poles for 136 seconds we have the speed in miles per hour.

COLORS FOR PIPING

A System of Enameled Signs to Suggest the Fluids Carried by the Color of the Sign

By Francis G. Wickware

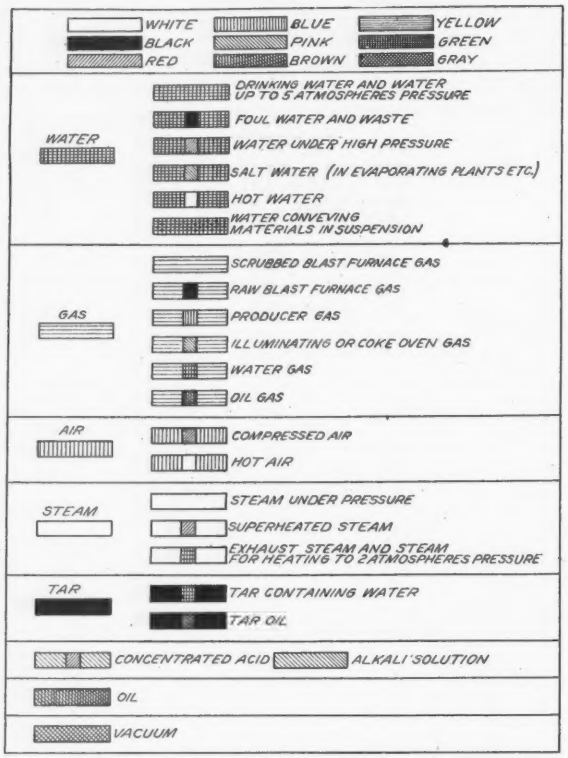
PIPING in the modern industrial plant has reached a degree of complication which not only makes its maintenance a serious problem for the operating engineer, but renders even the identification of its elements a matter of considerable difficulty. Hence, aids to memory of various kinds have been devised for the identification of piping systems. The most common is the use of distinguishing colors for various materials, an extension to practice of a device universally employed in the making of plans.

First Suggestion

ONE of the first to attempt to place piping identification by means of colors on a systematic basis was the late William H. Bryan, who, in a paper published in the Proceedings of the American Society of Mechanical Engineers in June, 1908, described a number of schemes, among them that employed by the United States Navy, and offered recommendations for the development of a universal system. The basis of such a system he summarized as follows:

1. It must be applicable to plants of all types and sizes.
2. To prevent confusion it must be adaptable, so far as possible, to systems already in use.
3. Colors should be chosen, so far as possible, which will naturally suggest the materials they are intended to represent; e.g., white for steam, blue for water, red for fire protection, brown for oil, etc.
4. The system should be of the greatest possible simplicity.
5. Pigments should be used which will resist the action of heat, cold, water, normal wear and even continued neglect.
6. Harmony of colors should be considered as far as possible. Tones should be chosen capable of easy reproduction.
7. The scheme should be so designed as to be applicable to the representation of piping systems on plans.

Bryan suggested a list of 58 individual signs desirable in a universal system.



A PROPOSED UNIVERSAL SCHEME FOR COLORS TO DISTINGUISH USE OF PIPING

The Proposed Universal System

BASED on this list G. Fontius, presented to the Association of German Ironmasters a scheme which was taken up officially; and the question of its recommendation for universal use was placed for consideration in the hands of a small committee of experts. The German Society of Engineers, the Mining Institute of the Dortmund District, the German Central Heating Association and the German Society of Inspecting Engineers offered their co-operation, and the commission was extended to include representatives of these societies. Their recommendations are published in a recent issue of the "Zeitschrift des Vereins deutscher Ingenieure."

The report points out the great danger which lies in the diversity of the systems in use in German works. The individual color schemes have amply fulfilled their purpose of enabling engineers and workmen quickly to identify piping systems in case of accident and easily in the regular operation of the plant. But when engineers or workmen change from one plant to another, the inevitable confusion of 2' color schemes in which the same color may be used to indicate widely different materials, opens the way to serious mistakes or even accidents, particularly in the excitement of sudden interruptions of service.

The commission undertook to devise a color scheme, involving only a small number of basic colors, for the more important piping systems, so arranged that through various combinations of the colors the scheme could be extended to any desired degree without destroying the fundamental simplicity of the indications.

Color Scheme

THE commission suggest fundamental distinguishing colors for steam, gas, water, air, tar, oil, vacuum, and chemical solutions. The colors, chosen so far as possible to suggest the materials they are intended to indicate and thus easily fixed in the memory, are as follows: Water, green; Gas, yellow; Air, blue; Steam, white; Tar, black; Oil, brown; Vacuum, gray; Chemical Solutions: Alkaline, pink; Acid, pink with red stripes.

More detailed indication of the function of the piping systems and of the pressures, temperatures, impurity or composition of the materials they carry is to be obtained through various combinations of these fundamental colors. Thus, danger is indicated by red, impurity by black, mixture with steam by white, with water by green, with air by blue, and

with oil by brown. The direction of flow is indicated by arrows. The scheme is thus capable of any desired extension.

The single important disadvantage, and this was thoroughly considered by the commission, is in indicating steam by white. The indication of steam pipes on plans cannot be by simple lines, hence, fine double lines must be used. The commission, however, considered this disadvantage of small importance compared with the representation of steam by its characteristic color.

Many suggestions have been made for the practical application of the colors to pipes. In very rare cases is it desirable to paint the whole system. Usually it is sufficient to place the indications at important points only, such as junctions or crossings. The commission recommended that the colors be enameled on metal strips 4 to 6 in. wide and these strips attached to the pipes. On account of the influence of temperature, oil paints should not be used; neither should the paint be applied directly on the insulating material, where it is very rapidly discolored. The enameled strips are easily attached, are easily cleaned, and are not easily detached or defaced.

PREVENTION OF INDUSTRIAL ACCIDENTS

Safeguarding Workmen Around Boilers, Engines and Motors

By Frederick R. Hutton

IN the majority of cases the motor energy on which all modern production is based, is the prime cause of industrial accidents. Accidents do not happen when the works are shut down. It is so common to surround the moving parts of the power plant by railings, that it seems scarcely necessary to illustrate safeguards in this class. A disaster, however, hangs

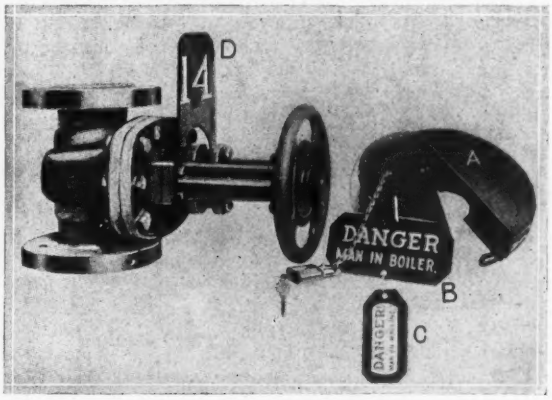


FIG. 1. SAFETY LOCK FOR STEAM VALVES

over the workman around a boiler, which the safety device shown in Fig. 1 seeks to prevent, and against which it has been found entirely effective. This device for preventing a steam valve from being opened upon a line where people are at work, consists of a sheet-steel casing which fits around the handwheel. It is locked in place, and the key given to the man most interested. The engine down the line on which men are working cannot be started; steam cannot be turned into a boiler within which a man is working; acid cannot be turned into a tank or vat within which repairs are in progress; and a wide group of most distressing accidents are precluded where this safeguard is used.

Figure 2 shows a safeguard identical in principle and operation where the danger may come from an unauthorized closing of an electrical switch which the repair-man opened when he went to work. The key of the padlock is, as before, in the pocket of the man most interested, and the current cannot be turned on the line until he unlocks the lock.

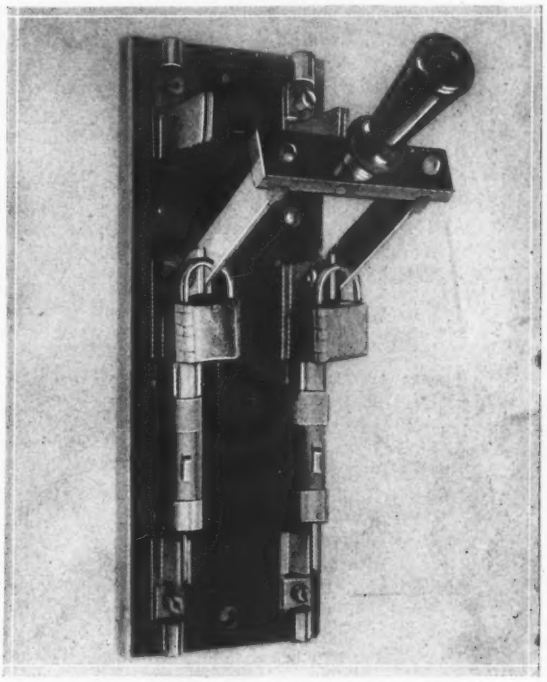


FIG. 2. SAFETY LOCK FOR ELECTRIC SWITCH

The next great avenue of disaster is to be found in the belts or gears through which power is passing. The main belt is usually massive enough to act as its own warning sign. The smaller transmissions, however, are those with which the workman is usually more intimate, and from which his greatest danger arises. Small belt pulleys and gears should be surrounded by a sheet-iron casing which can easily be removed.—Machinery.

Lubricating and heavy paraffin oil were exported from the United States in the 9 months ending March, 1912, in quantity amounting to 141,895,584 gal., valued at $18,258,752. Of this quantity 44,427,443 gal., valued at $4,913,439, were exported to the United Kingdom; Belgium, 9,424,953 gal., valued at $1,120,132; France, 16,457,539 gal., valued at $1,976,147; Germany, 16,636,750 gal., valued at $2,097,158; Italy, 6,839,323 gal. valued at $797,400; Netherlands, 9,357,386 gal. valued at $1,134,137; other European countries, 7,674,552 gal., valued at $1,059,963; Canada, 3,968,888 gal. valued at $577,766; Mexico, 884,317 gal. valued at $154,586; Cuba, 1,193,225 gal. valued at $387,053; Argentina, 3,680,492 gal., valued at $696,286; Brazil, 1,568,766 gal., valued at $354,593; Chile, 1,504,831 gal., valued at $358,878; British East Indies, 5,990,968 gal., valued at $687,148; Japan, 1,861,705 gal., valued at $329,820; British Oceania, 3,263,090 gal., valued at $481,398; British Africa, 1,537,050 gal., valued at $305,996; other countries, 5,624,306 gal., valued at $906,850.

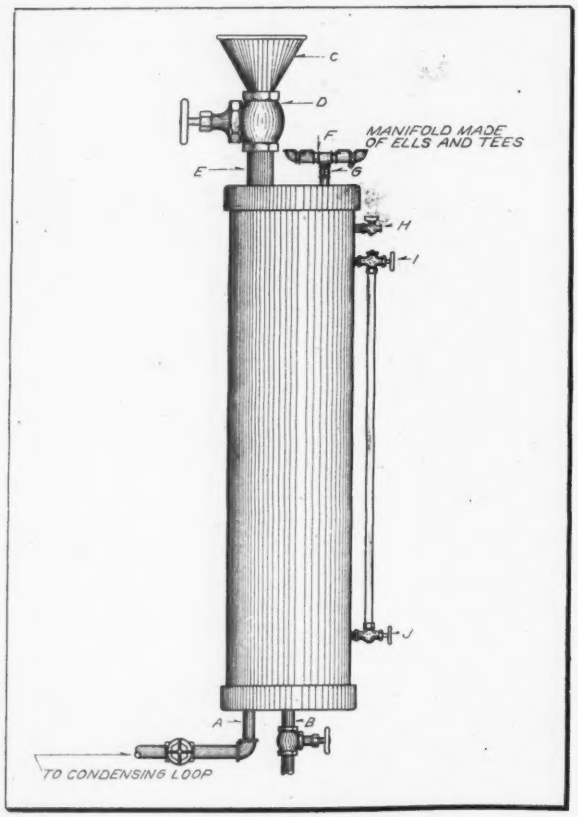
LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

A CENTRAL LUBRICATOR FOR STEAM ENGINES, PUMPS, ETC.

THERE are a number of mechanical devices on the market for delivering oil to the cylinders, engines, pumps, etc., in a plant, but it occurred to me that a hydrostatic lubricator rigged up for this purpose could be made easily and answer the purpose almost as well.

The body of the lubricator is made from a steam pipe and at each end are placed caps. In the bottom head a steam connection A is attached, this connection being through the loop usually used in connecting up lubricators. The connection B is a drain for the condensed



MOME-MADE LUBRICATOR

water. At the top is placed the funnel C, which is attached to the body of the lubricator through a nipple E and cock D, used in filling the body of the lubricator. An air vent H is opened to allow air to escape while filling the lubricator. A manifold for connecting pipes to the various engines is shown at F which is made up of ⅜-in. ells and tees. A gage glass indicates the amount of cylinder oil in the lubricator and is attached to the body through gage cocks I and J.

This lubricator has been in use for 5 yr. and seems as good as new. I have 2 engines, one pump and a place where I test all the pumps and engines we make supplied by this lubricator. Albert F. Deppen.

DROP IN EFFICIENCY DUE TO SOFT SCALE IN FUEL ECONOMIZERS

IN a plant I was visiting recently I noticed the temperature of the water entering the economizer was 108 deg. and leaving it 169 deg. for one month's average, upon opening the machine a week later for inspection, the inspector said the tubes contained from ½ to ¾ in. of soft vegetable scale and he recommended boring this out, which was done, with a water turbine at 80 lb. pressure. After this, a month's record was taken and it was found the average was, 109 deg. entering and 198 deg. leaving, or a rise of 29 deg., or 2½ per cent saving in coal.

Many engineers claim that soft vegetable scale has no material effect upon the efficiency of the economizers because of its looseness and its porosity. The above proves to the contrary.

Alfred R. Eales.

WRECKED ENGINE

ONE Saturday our 1000-hp. engine broke down in a peculiar way. It broke down last March about the same way, too. The engine was originally built for 90 lb. pressure and to run 55 r.p.m., and was installed in the company's plant in another city, I am told. It wasn't there long until it was transferred here in the original design. It soon had a cracked frame and was damaged generally as a result of too much work to do; and the plant was not as big as it is now, either.

It was rebuilt to run 66 r.p.m. with 160 lb. gage pressure, with a cylinder 44 in. bore and 60 in. stroke. The head was knocked out which was supposed to be caused by the follower bolts working out and when it was repaired it seems they made the head a little thicker and stronger. Well, the head was strong enough this time to hold and as a result the connecting rod box cut off the crank pin and the rod dropped to the oil pit cast integral with the frame and was in the way of the continued revolution of crank which was kept in motion with the momentum of a heavy flywheel which is about 26 ft. in diameter with a 3-ft. rim about 3 in. thick. So the crank bent the connecting rod to a pretty fair circle and then the crank began to shear the steel key and crank itself.

The head was cracked half way across and the wrist-pin brasses were badly jammed and useless. The spider was shorn off on the upper half around as near to the center as the follower bolts, and the head end steam valve was blocked and the valve stem broken off square. The exhaust valve for the same end had its stem twisted and the head end of the cylinder was cracked through the steam valve port and the steam passages to the cylinder.

The engine, including the shaft and the flywheel, is at the factory now, as when they undertook to take the wheel off to send the shaft for a new crank to be put on, the roof supports, to which the chain supporting the unbalanced side of the flywheel was fastened, gave way and the wheel started on a destructive revolution around in its accustomed route of travel.

The steam separator was taken down and it was found that the deflecting plate had worked loose, probably from the jar of the engine and the engine was probably taking water. The engineer was taking an indicator card and had just stepped away from the head as it gave way. J. Davenport.

TROUBLE WITH A CIRCULATING PUMP

THE pump in question was a motor driven centrifugal pump traveling at a speed of 1750 r.p.m. against a pressure of 40 lb.

We had been operating about 3 months, 12 hr. a day when I noticed a peculiar noise inside the pump, sounding as though the impellers were striking something solid. At the first opportunity I shut down the pump and opened the water casing, finding nothing wrong with impellers, but the thrust collar on shaft next to the inner bearing of pump had been wearing on the bearing shells until it had worn a recess 3/32 in. deep.

The pump was bolted down to a wooden floor which in turn was nailed to stringers resting on the flanges of 10-in. I beams.

On inquiry, I was told the building was built in the winter and undoubtedly of green wood. At that time the pump was level and the 2 halves of coupling were in perfect line. While inspecting, I found that the 2 halves of coupling did not line within 0.018 in.

This change in position was due to the drying and shrinking of the floor planking.

I wedged up the end that was low till it was in perfect line. We ran that way for several weeks. Each week following, I made a careful examination of this coupling and found it was continually changing due to the weather conditions.

It was decided a concrete foundation would be best to overcome this trouble.

After the installation of the latter we had no further trouble with couplings getting out of line.

R. S. M.

BOILER CAPACITY

THE present day theory is to work a boiler up to capacity and overload; the more overload the more economical; but in my experience a boiler is like a man—the more overload the quicker it falls down.

With and without alkalis in the boiler, if it is forced in any way you have a great tendency to lift your water from the hottest parts of a tube of return tubular boiler, and when the water leaves the tubes or shell for a few seconds, with an extremely hot fire the result is a bag, and it is not necessary to have any oil or any deposit in the boiler, but the part where the deposit may lay will certainly come down because the water is a much longer time in getting back to the metal.

I have adopted a method of running plenty of boilers to try and meet all emergencies and quit forcing them, and find it reduces my troubles considerably. I have made a test of coal consumption on forcing boilers and having plenty of boilers to meet all needs and I find the coal consumption is a very small percentage more in having plenty of boilers, but is overcome by reducing boiler repairs. I wish some of our readers would make tests of coal consumption and let us know how they find things.

The way I argue this thing is: If you have just enough boilers to run your plant under ordinary conditions and should those conditions change, as a condenser lying down, or an extra heavy load, electrically, then you must push your boilers possibly 25 per cent or 50 per cent more, and if one boiler lays down by bagging then the remainder of boilers must work harder, or shut down your plant, which no engineer or fireman feels very agreeable to.

My remedy is to treat your boilers like humans and they will not be so apt to kick you out of the door, or try to put you through the wall. Geo. T. Everill.

HOME-MADE FILTER

I AM enclosing a sketch of a filter that I made here to get rid of red core in our ice. We have been bothered for some time with red core and as the owner claimed to be too poor to buy a filter to put between our storage tank and the can filler I had to exercise my wits.

This is made of a section of 8-in. pipe 36-in. long threaded at each end. The bottom end, next to the floor is capped and a hole drilled and tapped in the cap for 1-in. pipe which leads to the storage tank, 2 in. above this I soldered, on the inside, a disk

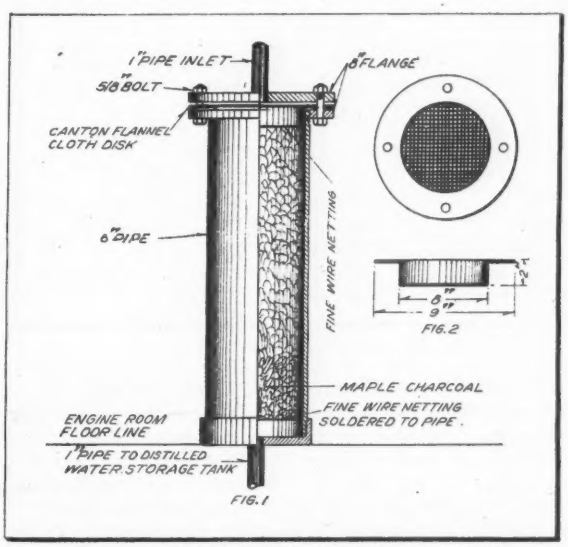


FIG. 1. CROSS-SECTION OF ASSEMBLED FILTER
FIG. 2. WIRE NETTING PAN

of close brass wire netting the space above this is filled with maple filtering charcoal, to within 2 in. of the top, then the brass wire netting shown in Fig. 2 made in the shape of a pan fits inside the 8-in. pipe and rests on the flange screwed on this end.

On top of this I placed a disk made of 2 layers of canton flanel sewed together, just large enough in diameter to rest inside the bolts, (same as an ordinary gasket), then the top flange is put in place and screwed down with the 5/8-in. bolts 4 in number. This cloth disk can be taken out in about 3 min. and a new one placed in.

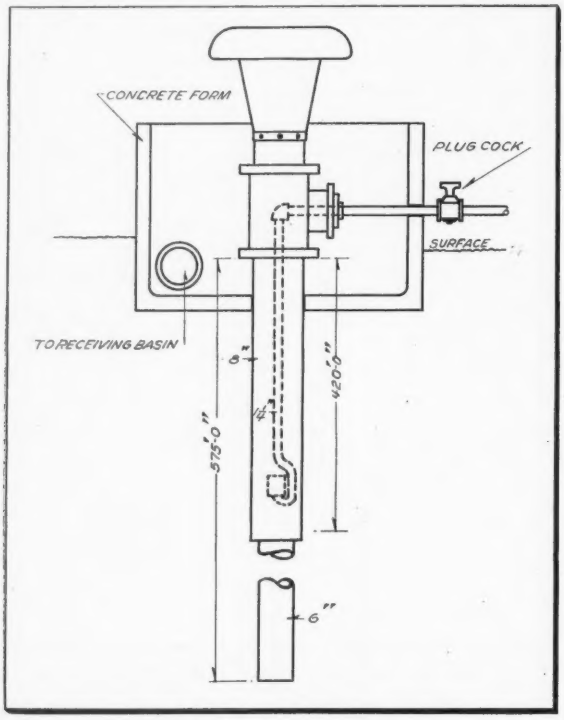
I have tried this over a month and we have no more red core. The entire cost of this was not over $5 being made of materials found in scrap pile.

T. M. Street.

SUCCESSFUL AIR LIFT

IN the issue of June 15, I noticed N. F. S. asks why compressed air cannot be used to raise water from 150-ft. wells. Let N. F. S. get in communication with the Harris Air Pump Co., Indianapolis, Ind.; they will give him the information desired. If he will read the article appearing in April 1 issue, he will see that we have in operation 2 wells; one 127 ft. deep, the other 130 ft. All that will have to be determined is the proper submergence.

I enclose a sketch of our deep well. The whole depth of the well is 575 ft., 8 in. to 420 ft. and 6 in. from



SKETCH OF AIR LIFT WELL

420 to 575 ft., and fitted with a Cook strainer. This well is fitted with a Harris Special Air Pump. The air is supplied to the pump through a 1¼-in. pipe, submergence 155 ft. This well formerly yielded 350 gal. under direct suction; it now yields with compressed air 1000 gal. per min. About 285 cu. ft. of air per minute is required with gage pressure of 51 lb. The water in the well when not being pumped, flows to within 11 ft. of surface. With well in active operation with compressed air and yielding 1000 gal. per minute, water drops to 50 ft. from the surface.

Frank C. B. Spence.

BAD WATER CAUSES SHUT-DOWN

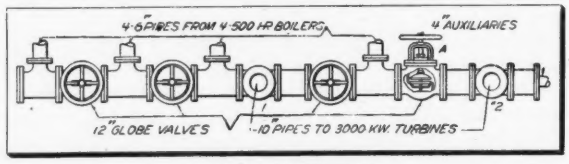
WHILE the writer was up in a Michigan town spending the summer a shingle and heading mill could not secure an engineer so I accepted the job, but 2 weeks was enough for me. They feed water in the boiler through the blowoff pipe with an injector, take it from 3 holes dug in the ground, the boiler was washed out every Sunday with water, using a hand pump. On Monday, Tuesday and Wednesday the boiler worked very good, but on Thursday it would start to foam and by frequently blowing it down would get through the day, but on Friday it would be so bad that the draft had to be closed, and throttle closed, and on Saturday we would have to close down at noon; the owner asked me what was the cause of it, as it had nearly always worked that way and that was the reason he could not get an engineer as they would get scared and leave. I told him that feeding his boiler through the blowoff pipe with the water from the mud holes washed the mud down on his fire sheet and this caused the foaming, and if he did not change it that his boiler would go up in the air, and he said he had been in the mill business and around boilers, for 25 yr. and would not allow a young fellow like me to tell him anything like that. I told him that if he would get one length of 1¼-in. pipe that I would change the feed line and run it up over the top to behind the dome down between the flues and put on a tee, the other material I had on hands. He took an arbitrary view of the case, saying there was nothing wrong with the blowoff feed, so I finished the week out and in about 2 weeks the boiler went up about 200 ft. in the air and came down about 150 ft. from where it started. As it happened early in the morning there was only the night man there and nobody was hurt.

A. U. Wolfe.

ONLY A CLOSED VALVE

THE sketch shows our main header which carries 200 lb. pressure superheated 75 deg. from 4 500-hp. water-tube boilers, there are 4 12-in. division globe valves and 2 10-in. pipes going to 2 3000-kw. turbines.

When these turbines were first started and tried out it was found No. 1 could carry 80 per cent overload whereas 20 per cent overload would bring No. 2 to a stand still. Everything was new, the operating



PIPING TO TURBINES

crew thought that the trouble lay in the design of the blading or the nozzle of No. 2 turbine, and did not investigate further. In fact every thing was said against No., 2, until the chief, who was opposed to globe valves on the line, noticed the valve at A, which was found to be opened only 4 turns, when the valve was opened wide No. 2 turbine carried as big an overload as No. 1. As there are 4½ threads to the inch the disk was raised off the seat not quite an inch, and we have been wondering since, how it carried anything near her rated load.

Thomas Sheehan.

FRICTION AND LUBRICATION

ON page 641 of the issue of June 15, 1912, H. P. mentions a bearing that runs hot in summer and cold in winter. It is a little hard to diagnose the disease accurately without having a look at the patient's tongue, but there are certain other symptoms which may help, and whether we get at H. P.'s particular trouble or not the points which may be brought out are of interest.

For example, it is entirely possible that the bearing is so designed as to radiate heat rapidly. In this case the temperature of the room will have its effect on the temperature of the bearing, for when the air is cold, the heat of the bearing due to friction will

be dissipated faster than on a hot day. This is a small matter perhaps, but in case the pressure, speed, oil used, etc., create conditions which approach closely to the limit of cool running, then this matter of dissipation of heat may be the "last straw."

That the temperature of the air is not generally recognized as one of the contributing causes of hot or cool running may be due to the fact that we overlook what we are familiar with, but its effect may be illustrated and made clear by recalling the effect of the more familiar remedy of playing a stream of cold water over a hot bearing. The principle is exactly the same, and the result differs in degree only. The amount of cooling due to cool air may be slight, but where the limit of cool running is approached this small amount may turn the scale.

At this point the objection is made, "How can a difference of say 60 deg. in the air make a difference of a few hundred in the bearing? I can see how it could make a difference of 60 deg. in the temperature of everything, bearings, engine bed, and furniture for that matter, but not how 60 deg. can produce several times that amount."

To get at the bottom of this seeming inconsistency will require some consideration of friction and lubrication and of the causes of heating.

In the first place, let us recall the effect of 60 deg. on molasses. Then apply this to oil, though in a lesser degree. In the second place, let us inquire, why limit the bearing pressure, or why not place unusually heavy loads on small bearings? Answering the second question first, it is easily possible, with a given oil, to load a journal heavily enough to break through the film of oil, that is, to use so great a pressure that the film of oil will be squeezed out or will not follow the journal out of the oil grooves and around the bearings. When this results, we have metallic contact of the surfaces and unlubricated friction.

Now, when this condition barely exists, suppose that we use a heavier grade of oil, or more body, an oil therefore which does not so easily squeeze out under pressure; that it, an oil of greater viscosity. If it does not so easily squeeze out from the surfaces, it will evidently carry a heavier load, without the film breaking and allowing actual contact of the rubbing surfaces themselves. But suppose we heat this heavier oil, say only 60 deg. Try it, a drop on a pane of glass. Tilt the glass until the drop runs an inch in a certain length of time. Then warm it in front of a furnace and note by its flow (at the same slant) its greater fluidity.

A consideration of these points will make it clear that if under a given speed and pressure, a light oil is at the breaking point, an ordinary season's change in temperature may so increase its fluidity as to permit the bearing surfaces coming into metalic contact and the cause of the resulting rise in temperature is plain. The remedy is then, a heavier oil in hot weather. Why not use a heavier oil all the time? Because its thickness or viscosity causes an increase in friction, or a slight waste of power.

The matter may be well illustrated by what is perhaps the most extreme case of common every day practice, namely, freight car lubrication. Most railroads, in their attempt to haul as many cars as possible behind each engine, use a thin oil in winter, for the low temperature makes the oil "thick" enough to stand up to its work, but in the summer's heat this same oil would become so fluid as to break through and cause an increased number of hot boxes. In summen, then, a heavier oil is used, one which in spite of the heat will retain sufficient viscosity but which if used in cold weather would cause increased friction even if it did not become so thick, under severe weather conditions, as to fail entirely in its purpose.

D. R. Hettrick.

CONVENIENT FLUE BLOWER

DRAWINGS Figs. 1 and 2 are of the flue blower which I made out of pipe and pipe fittings, the cost is very little compared with those you purchase and the results have been very satisfactory. Figure 1 shows the blower in position when installed and at the time the flues are being cleaned. A 1-in. black iron pipe, A Fig. 1, is connected by the use of short 1-in. nipples, and 1 by 1 by ½-in. tees to the vertical pipes, which are

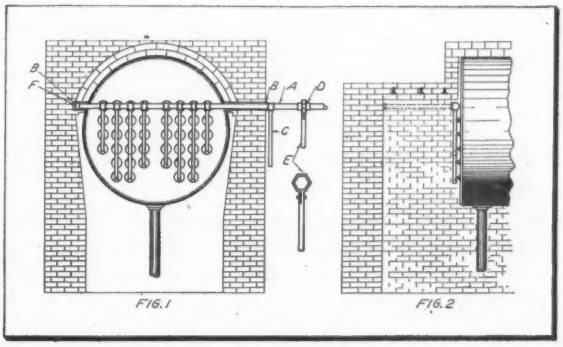


FIG. 1. REAR VIEW OF BOILER EQUIPPED WITH FLUE BLOWER
FIG. 2. VIEW SHOWING OPERATION OF FLUE BLOWER

made of ½-in. pipe of the desired length, with a cap on the lower end. Small holes were drilled 3/16-in. in diameter in the pipes and spread opposite flue centers, the tees were also drilled with the same drill, 3/16-in. in diameter, as will be noticed in Fig. 2. B, B, are short pieces of pipe of the desired diameter, cemented in the brick wall; these answer as bearings for the 1-in. pipe to rest and rotate upon. C is a lever which is connected to the 1-in. pipe by a 1 by 1 by ¾-in. tee, the lever being made out of ¾-in. pipe of the desired length. This lever is used to operate the blower. D is a 1-in. union, and by means of the lever E, which is clamped around the union nut, the union is tightened and loosened at will. There must be a lead gasket used in the union. F is a cap placed on the end of the pipe.

When the blower is to be used the steam is first turned on, and while the blower is in the position shown by the dotted lines in Fig. 2, all the condensation will be run in the combustion chamber, when the operator thinks the steam is dry and free of water he lowers the blower to the vertical position, by loosening the union, and when in position tightens the union again. The blower is always to be left up in the horizontal position when not in use, and is held in this position by tightening the union.

Readers of this paper desiring to build and use one of these blowers, will find it convenient and worth many times the cost and time taken to build it.

Chas. H. Sparber.

IRON LOSES its magnetic property when heated to redness, but recovers it when cooled to black heat. On account of this property magnetic separation of iron from molten metals cannot be made.—Mining and Engineering World.

Successful Kinks From The Plant

For Saving Time, Work and Trouble

Heating Kinks

WHERE wall coils are hung on 2 by 4 posts spiked to the brick walls we have much trouble with the hanger posts pulling loose especially in places where the operatives are in the habit of throwing things behind the coils and in climbing on them. This we have overcome by clamping the tops of the post by means of the expansion bolt and clamp bar shown, also in some of the rooms we have much trouble on account of hooks being broken off and allowing the pipes to sag, this is done by the boys climbing on the pipes, especially at the windows, we have overcome this by clamping the coils between 2 ⅜ by 1¼-in. iron bars as shown.

In the shop where I am employed the buildings are mostly one story and cover quite a little territory. We use a gravity return system of heating and have more than a thousand feet of return pipe beneath the floors and buried in the yard. When I put the system in at first I laid the pipes in an oak box packed with mineral wool. The ground is clay and in many

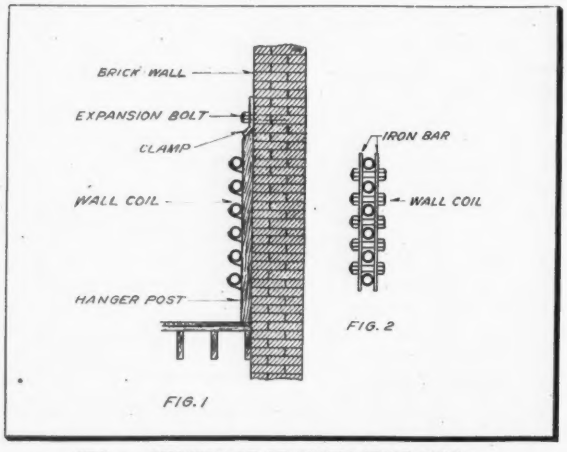


FIG. 1. METHOD OF SECURING WALL COILS
FIG. 2. PREVENTING SAGGING OF HEATING COILS

places saturated with salt and acid, this job lasted 18 months. The next time I placed the pipe in the box suspended without packing, this job lasted 8 yr. But we don't like breaking up the cement floors and it makes the boss hate the sight of us for 6 months after we do it, so when they put up a new building 5 yr. ago we ran a cement sided and covered tunnel around the walls to carry the main return pipe and where we did not think it necessary to run a full sized tunnel we ran cement conduits with provision for fishing in the pipe, in all cases, without disturbing the floor but little. In some places we made the conduit of a larger size pipe surrounding it with concrete; the main tunnels are 30-in. wide by 36-in. deep the tops are reinforced with old pipe laid across the tunnel.

All the pipe laid in the yards are well wrapped with tar paper and surrounded with 1-to-3 sand cement mortar. This works very well, some of it has been in 8 yr. and is still good. There is, of course, some loss of heat owing to the pipes not being insulated but most of it goes to heat the floors and anyway we heat with exhaust steam and have more of it than we need.

In piping live steam to the superintendent's house I drained the trench to the sewer and insulated the pipe with a double air-space box and filled the box with insulating material. J. O. Benefiel.

Another Lubricator Kink

WHILE looking over Practical Engineer I read with some interest the Lubricator Kinks submitted by L. A. Danner, which recalled to my mind the many things I have seen tried and the various methods suggested by engineers in order to keep the sight feed glass of a lubricator clean. I accidently discovered what I think is the best and easiest means of keeping these glasses clean. I was for some years employed as chief engineer of a brewery plant in which there were 18 sight feed lubricators installed to lubricate the steam cylinders of the various engines, pumps, etc. We were using a very good quality of cylinder oil which gave us but little trouble in this respect. One day there strolled into the engine room an oil salesman who guaranteed to supply us with a cylinder oil which would give as good results, and as he had talked with the owner of the plant before he saw me and offered the oil at a price that was 10 cents lower per gallon, there was nothing for me to do but give the oil a fair trial.

This I did and found the oil to be perfectly satisfactory in every respect as far as the lubricating qualities were concerned, but it was almost impossible to keep the sight feed glasses clear. The oil was a very heavy oil, which the oil men call a slow feeding cylinder oil; it would run up the side of the glass and when used in a lubricator situated in a cool place, the drop would become so large that it would fill the glass entirely, under which conditions it was impossible to regulate the flow of oil to the required amount.

This plant contained a 2-stage carbonic gas compressor, used to collect the gas for carbonating purposes. The cylinders of this compressor were lubricated with a mixture of commercial glycerine and water—1 part water to 2 parts glycerine. This compressor was located in a very cool place and particularly in the winter it was impossible to keep the sight feed glass of the lubricator on the steam cylinder clear.

One night, after I had made some repairs on this compressor, it occurred to me that it would be a good idea to try a little glycerine and water in the sight feed glass in order to see if this would overcome my trouble. After cleaning the glasses with a swab made out of a piece of waste tied on the end of a stick, the glass was filled with the above mixture, and it was quite a relief to be able to count the drops of oil as they passed up through the glass.

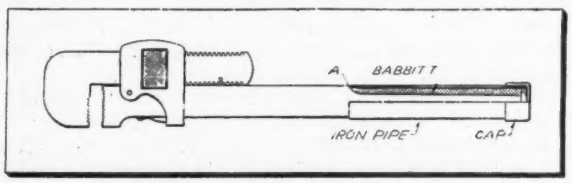
The funny part of it was that the idea occurred to me on the impulse of the moment. The other 17 lubricators were treated in the same manner with the same pleasing results. I have, since leaving this plant, operated a number of other plants and have always introduced this method of keeping sight feed glasses clean. I have known of some glasses to run for 3 months without having to be refilled.

I have suggested this kink to a number of my friends and in every case they have had good results. I have visited many plants in which I have seen many sight feed glasses that were so covered with oil that you could not see the drops of oil leaving the lubricator.

The sight feed glasses will, of course, have to be refilled periodically, as the glycerine will in time become absorbed by the oil passing through the glass. It is plain that the glycerine contained in the water prevents the oil from sticking to the sides of the glass. I have stood and watched a lubricator feeding in which the drop of oil was so large that it touched the glass in 2 places, which under ordinary conditions would have followed the glass its entire length. There have been many things tried to bring about this same result, from filling the glass with kerosene oil or naphtha to soldering a piece of pointed wire to the plug at the top of the glass, but the method I have described above is the only one from which I have obtained really good results. W. S.

Making Wrench Handle

THOSE who have wrench handles broken, can make them as good as new by referring to the illustration, which is of a 14-in. wrench. Take a piece of ¾-in. brass pipe threaded on one end for a cap. It can be made as long as desired. Leave the nut on the



WRENCH HANDLE MADE OF PIPE

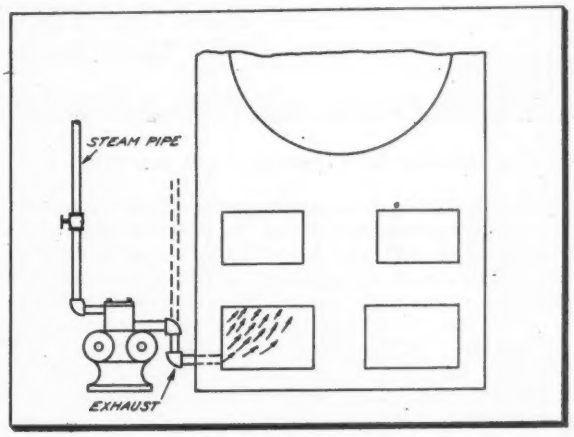
stem, put the pipe in a vice upright and heat some babbitt or lead in a ladle, put the wrench in as far down as possible. Hold it plumb and pour the babbitt in at A until full. Be sure to heat the pipe first, for good results allow 2 min. to cool and the job is done.

A. Waldron.

A Good Remedy for Clinker

I AM engineer in a flour mill and have my own firing to do. Like other firemen, I sometimes burn pretty bad coal and heavy clinker formed on the grates, although I would keep water in the ash pit.

I would lift the clinker off the grates and rake it out at the furnace doors, which is not a very pleasant job, especially in hot weather. Every 4 weeks when I cleaned by boiler I would have to get in the furnace with chisel and hammer and clean the grates, which is another irksome job. My engine exhausts into the feed water heater and my pump is near the boiler wall. The exhaust pipe ran through the roof of the building, as shown by dotted lines in sketch. I cut a hole through the boiler wall to the ash pit, took down the exhaust pipe, used 2 short pieces of pipe and an ell and ran the exhaust through the wall to the ash pit, so the pump exhausts into it, as shown in the sketch.



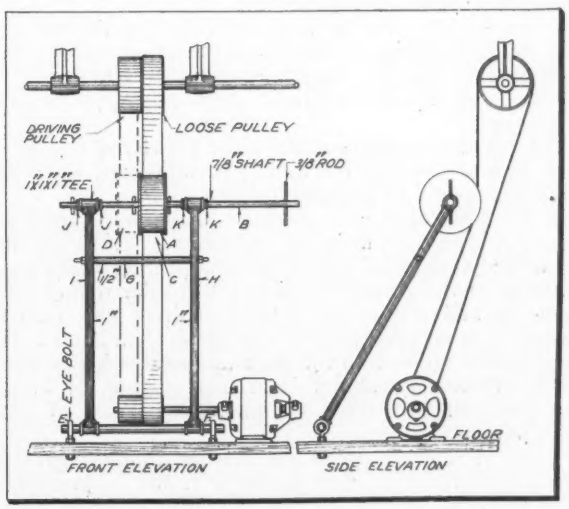
PUMP EXHAUSTING INTO ASHPIT

I made the change 7 yr. ago and have not had to use the slice bar since, and the grates are always clean. Considerable saving in coal was noticed after this change. If an injector is used a pipe from the heater would work just as well.

Ed. G. Clary.

Home-Made Idler

ENCLOSED sketch is of a light idler I made for a well pump. A piece of ⅞-in. rod, pulley, 4 1 to ½-in. bushings, 2 1 by 1 by 1 in. tees, 2 1 by ¾ by 1-in tees, 3 pieces of 1-in. pipe, 3 pieces of ¾-in. pipe, ⅜-in. rod, and 2 eyebolts complete the list of ma-



LIGHT HOME-MADE IDLER

terial. The pulley, A, runs loose on rod, B, and can be moved from position, C, to D. The idler is supported by 2 eyebolts that extend through the floor as shown at E and F, G strengthens HI, JJ and KK are 1 to ½-in. bushings reamed out to ⅞-in. for bearings for shaft B. J. B. Linker.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Miscellaneous Questions and Answers

WILL carbon dioxide condense at its normal pressure and temperature when in the presence of nitrogen and other diluent gas, or will the point of liquification be at about the average of the sum of the two gases?

2. If so, what will be the probable temperature and pressure of liquification of a gas consisting of 20 per cent CO_2 and 80 per cent N, with a small percentage of other gases, such as compose the products of combustion?

A. Carbon dioxide will condense when diluted with other gases practically as though the latter were not present. It liquifies at 0° with 36 atmospheres.

3. How could the two gases be separated after being liquified?

A. The carbon dioxide would easily be separated from nitrogen and other similar low-condensing gases, by freezing the former before the latter begin to liquify.

4. Would the CO_2 freeze, when introduced in the field of a strong magnet, the same as oxygen in liquid air?

A. We are unaware of any condensing action on gases due to a magnetic field.

5. Will chloride of lime affect the lubricating qualities of aquadag when introduced to prevent freezing?

A. No, if chloride of calcium is meant in the question, as is undoubtedly the case.

6. What is the average efficiency of the air injector, when using air at 500 lb. initial pressure, compressing at a range of pressure from 5 to 300 lb.?

A. No data are available regarding efficiency of air injectors.

7. What companies make the powdered fuel producer, and why is it not more generally used when its advantages are so apparent?

A. Powdered fuel producers have been tried at various times by different companies. None of the standard companies are at present putting these producers on the American market. Powdered fuel cannot be stored for any length of time due to the dangers from spontaneous combustion. Some of the difficulties are due to the high temperatures that prevail, clinkering, caking, formation of slag on lining of producer and excessive maintenance cost of producer linings.

8. Will the ratio of gasification diminish greatly in a gas producer when operated at 500 lb. pressure?

A. No.

9. What would be the probable percentage, over one operated at atmospheric pressure?

A. Inappreciable.

10. What amount of coal is consumed for power purposes in the world annually?

A. Approximate annual coal production of the United States, 450,000,000 short tons. Used by railroads of the United States, 90,000,000 tons.

In Chicago the use of coal is divided as follows:

Central district plants	15 %
Miscellaneous power plans	45 %
Flats	7.5%
Domestic purposes	6.5%
Special furnaces, etc	6 %
Railroads and boats	20 %

Assuming this division to hold approximately for the United States the estimates are as follows:

Power plants	270,000,000
Railroads	90,000,000
Annual total for power purposes	360,000,000

The world's annual production amounts to approximately 1,210,000,000 short tons. If the division of coal for power purposes throughout the world is figured on the same basis as that for the U. S. the coal used annually for power purposes in the world amounts to 970,000,000 short tons.

11. How many hp. of engines are in use in the world, with heat as motive power?

A. The U. S. Census shows the following capacity of prime movers used in the United States for the years mentioned:

	Installed Horsepower.
Manufactures, census 1905	12,765,594
Mines, and quarries, census 1902	2,753,555
Street railways, census 1902	1,359,289
Electric light and power stations, census 1902	1,845,048
Custom flour, grist and saw mills, census 1900 (omitted from census 1905)	883,685
Telephones, telegraph and fire-alarm systems, census 1902	3,148

In 1909 it was estimated that the aggregate horsepower for industrial purposes of engines using heat as a motive power in the U. S. amounted, in round numbers, to 20,000,000, not including locomotives. The number of locomotives in use annually is roughly 50,000. These locomotives can develop 30,000,000 hp. The general estimation is that the average power developed by these locomotives per 24-hr. day averages 2,000,000 hp. It is further estimated that if all the railways were electrified the central stations used in connection with railway work would aggregate about 4,000,000 hp.

Of the 20,000,000 hp. used for industrial purposes about 800,000 hp. is developed by means of gas and oil engines.

12. Would water be decomposed and remain so when sprayed into a current of gases at say 2000 deg. F.?

A. No.

13. What is the probable explosion pressure of hydrogen and oxygen, when liquified and introduced into a container sufficiently strong to prevent its bursting when heated to 100 deg. F.? The gases to be generated by electrical decomposition of water and consequently in the proper proportion for complete combustion.

A. No explosion occurs between hydrogen and oxygen until their ignition temperature is reached, and this is much above 100 deg. F. If the temperature were sufficiently raised to cause them to explode under the other conditions, the pressure evolved at 100 deg. F. would be about 1250 atmospheres.

14. Will 14,000 lb. per sq. in. be the probable pressure when heated at atmospheric temperature and confined in the same space as the liquid?

A. Approximately.

15. The heat value of wood is quoted according to the carbon contents, why is not that of the hydrogen added?

A. Wood is composed mainly of carbohydrates, compounds in which the hydrogen and oxygen are present in the proportion to form water. It has been found by experiment that when hydrogen and oxygen are present in a carbon compound, heat value of the compound is represented by assuming that that part of the hydrogen equivalent to the oxygen present, is without heating value. Since in wood all of the hydrogen present is in the proportion equivalent to the oxygen, none of it represents heating value, so that carbon remains its only heat producing element.

16. Do the hydrogen and oxygen chemically combine when distilled from wood?

A. When wood is distilled, some of the hydrogen and oxygen combines with the carbon, producing a variety of compounds, as acetic acid, methyl, alcohol, etc. The greater part of the hydrogen and oxygen, however, are driven off as water.

17. What is the average composition and heat value of gases distilled from wood, assuming no water to be present, and how many heat units are required to distil the gases from a pound of dry wood?

A. The composition of the gases driven off in wood distillation is approximately 50 per cent carbon dioxide, 25 per cent carbon monoxide, 8 per cent methane and small quantities of other gases. In practice these are mixed with considerable nitrogen and oxygen, accidentally entering from the air, so that the heat value is only 80 to 100 B.t.u. per cu. ft. About 2000 B.t.u. are required to distil one pound of wood.

18. What is the average quantity of tar, ammonia, sulphate, etc., derived from the distilled gases of wood, and what portion of the heat value do they contain?

A. No ammonium sulphate is made by wood distillation. The tar represents about 5 per cent by weight of the wood and perhaps 10 per cent of its heat value. R. H. Fernald.

Overloaded Engine

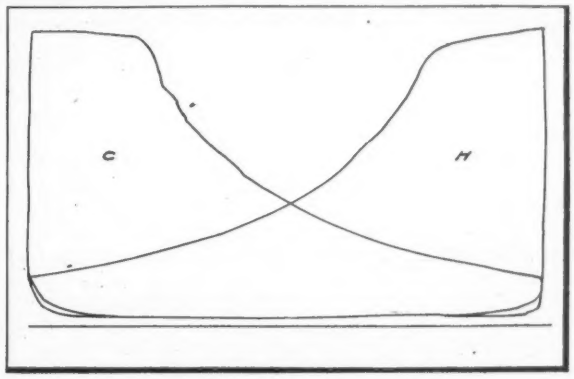
I AM in charge of a 26 by 48-in. Corliss engine running 80 r.p.m., steam pressure 140 lb. The engine and boilers are overloaded. Judging from the accompanying card, what changes can be made to decrease steam consumption? W. A. W.

A. In submitting the card with your inquiry, you neglected to state the scale of the spring used in taking the diagram, but it scales closer to a 60 than anything else, and this is perhaps what you used. Assuming this to be the case, we find that the m.e.p. is practically the same at each end, being slightly greater at the head end, but not enough to cause any anxiety. The m.e.p. is 70 lb.

Figuring out the card on this basis, we find that it shows 721 i.hp. As you carry 140 lb. of steam, a 60 scale shows that the initial pressure is only about 134 lb. While there is always some drop in pressure, in a well designed system it should not be to exceed over half of what you have, viz., 6 lb.

If your pipe line is long, uncovered, or too small, or if live steam is withdrawn from the main between the engine and the boiler, any one or combination of these several faults will tend to reduce the initial pressure. Sometimes, if a steam separator is used, its design is so faulty that the steam is compelled to travel through tortuous passages and thus reduce the pressure. Fortunately, however, faulty steam separators are rare.

Your load is exceptionally well balanced between the two ends of the cylinder. You can secure a little more economy in the steam consumption by advancing the eccentric on the shaft in the direction in which the engine runs, from a half to three-quarters of an inch. This cannot be stated with absolute accuracy on account of not being acquainted with the conditions.



CARD FROM OVERLOADED ENGINE

There is every evidence that the valves leak quite a little, and perhaps the piston also. To test for piston leaks, place engine on the center after operating several hours so that the test will be conducted while the engine is hot, and under running conditions. Then by operating the valve gear by hand, admit steam to the end of the cylinder that has the greater volume and open the indicator cock at the opposite end and if there is any leak, it will show at once.

To test for steam valve leaks, with the engine still on the center, lap the steam valves and, having opened the indicator cocks, admit steam to the steam chest by opening the throttle carefully, and if the steam valves leak, steam will show at the indicator cocks.

To test for leaky exhaust valves, with the engine still on the center, place the wristplate in the central position so that the exhaust valves are lapped, and then by means of small wooden blocks, raise the drop levers a little and slip the blocks in between the trip steel in such a way that both steam valves will be open at least a little with the wristplate central.

Then open the throttle carefully, which will admit steam to both ends of the cylinder at once. Now note whether the steam in escaping past the exhaust valves into the exhaust pipe by opening a drip valve in the pipe, or any other method that the case might suggest.

At present you are using about 28 lb. of steam per hp. hr. and if you can reduce this to about 25, where it ought to be under good running conditions, you will cut out the evaporation of about 270 gal. of water per hr. or about 2700 gal. per day of 10 hr.

This would mean about 72 boiler horsepower that could be saved, which is quite an item when the boilers are overloaded. G. H. Wallace.

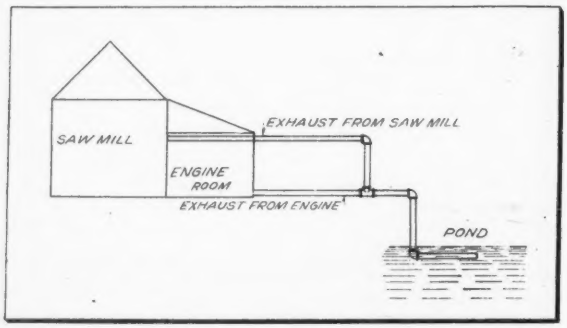
Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

Exhaust Steam Problem

WE are contemplating the installation of a hot pond into which all of the exhaust steam from our saw mill will discharge. The steam equipment consists of 2 60-in. by 16-ft. boilers, a 160-hp. engine and a steam "nigger" or log turner.

What we wish to do is to carry all of the exhaust steam through one large pipe into the pond to keep



PROPOSED CONNECTION OF EXHAUST PIPE WITH POND

it open late in the fall. The pond is small and it is proposed to run the pipe about 20 ft. into the water, 4 ft. below the surface.

Will there be enough back-pressure to be harmful and will a check valve be necessary. If any of the readers can give me advice I shall appreciate it. The accompanying sketch shows the proposed layout.

J. F. D.

Answer to Heating Question

REPLYING to P. C. in the June 15 number, if you use a single pipe to connect the coils I should suggest a 4-in. pipe for 1200 sq. ft. unless you have a very long run or an unusual number of turns. In using 2 branches, 3-in. would be plenty large enough and run 2-in. to each coil. These sizes are based, of course, on the assumption that you provide each coil with an air vent and have proper drainage. The coils and piping should grade 1 in. in 20 ft. in the direction of flow, if you use new pipe, some of the old pipe that went through the fire would need more than that.

As to the coils, I would suggest your making them of 1¼-in. pipe, as it will come out cheaper per square foot of heating surface than any other size.

It would take 16 1¼-in. pipes to give the same surface that you get with 11 2-in. pipes.

I do not see any particular advantage in the syphon you intend to use. A reducing valve would be better to let in steam during the night.

These coils total 1088 sq. ft.; with 10 per cent for mains would give 1196 sq. ft. or about 12 hp. of your exhaust and if your system is drained properly 2 lb. back pressure should keep up a circulation, whereas a ¼-in. hole blowing steam from 50 lb. pressure to atmosphere will use about 115 lb. of water per hour, or 3½ hp.

One-half this amount of steam run through a vacuum pump would do far more good towards keeping the air and water out, and then you could run with ½ or 1 lb. back pressure.

A. K., Jr.

Alining Vertical Shafting

IN the installation of deep well pumps of the centrifugal type with vertical shaft, is there any practical and sure way of lining up pump shafts as shown by the cut herewith? The shafts are from 100 to 160 ft. in length, with boxes about 7 ft. apart. The shelves are sometimes 18 in. wide, but the entire frame work

VERTICAL SHAFT SUPPORT AND ARRANGEMENT

is never true and must be lined in 2 or more sections. We have bored a line of 2-in. holes through the shelving, close to the box, and stretched a wire through, lining the shaft by this as best we can. Is there a reliable method of lining the shaft to this one wire?

B. J. M.

Those Air Compressor Cards

REFERRING to the indicator cards from an old air compressor which C. E. Anderson, in your issue of Sept. 1, invites readers to criticize, I note one or two things which one can't very well overlook.

On both the steam cards the steam admission and both the opening and the closing of the exhaust are

all too late. The cutoff of the left hand card is not sharp and is too early as compared with the right hand card, so that the latter has more than its share of the total load.

We are told that the air cylinder is of Ingersoll-Rand make, with discharge valves in the heads and "valves in the piston and piston rod." The expression which I put in quotation marks cannot be quite correct, but it seems to indicate the piston inlet. If so, the air cylinder cannot be as old as the steam cylinder, 32 yr., as the piston inlet is only a little over 20 yr. old. If it is a piston inlet the valves in both faces of the piston close much too late, reducing the charge of air per stroke 15 per cent or more. It is the habit of the piston inlet valve to close sharply at the beginning of the compression stroke, so that cards from this type of compressor usually show the compression line fully up to atmosphere at the very beginning of the stroke, and, on account of the inertia of the air inrush, the pressure is often slightly above atmosphere when compression begins. Mr. Anderson says nothing about the speed of the compressor, and it might be possible to get the inlet valves to act in this way if the machine was purposely slowed down to a speed far below normal. The valves also might stick if they were never cleaned or examined.

Frank Richards.

ON page 903 of Sept. 1 issue C. E. Anderson submits 2 cards for cristicism, 1 from an air compressor, the other from a Corliss engine which is running the air compressor. The Corliss card needs one change more than any other, and that is the eccentric should be pushed ahead which will make admission, compression and release earlier, because the admission is leaning to the center of the card, indicating that the clearance was not filled with steam at the start, and this was mostly because the exhaust valves closed so late and did not entrap any exhaust steam for compression which would have greatly assisted the filling of the clearance and aided steam taken from the boiler at the start. One end is doing more work than the other and this is to be equalized by changing the length of the governor rod, and as this engine is of the crab-claw type the safety cams should be reset, because changing the cutoff will change the position of the safety cams because they are both attached to the same thing; after these changes things will be beyond criticism.

The air compressor card shows some customary faults, as the discharge valve seems to be sticking and the jagged line at the top on the crank end is much higher at the start showing too much pressure required to open the discharge valve. The jagged discharge line is caused by the fluttering discharge valve when the charge of air is being forced into the air receiver. The suction air valve line or intake line shows the valve to be working freely because this line is very close to the atmospheric line. The air compression lines correspond closely to adiabatic expansion, and are therefore good. A. C. Waldron.

Location of Valves; Height of Water

ACCOMPANYING sketch is a reproduction of piping layout submitted by J. C. Hawkins in Aug. 1 issue of Practical Engineer. Mr. Hawkins asks for opinions of engineers as to the proper number of values to give best results and keep the cost down to a reasonable figure.

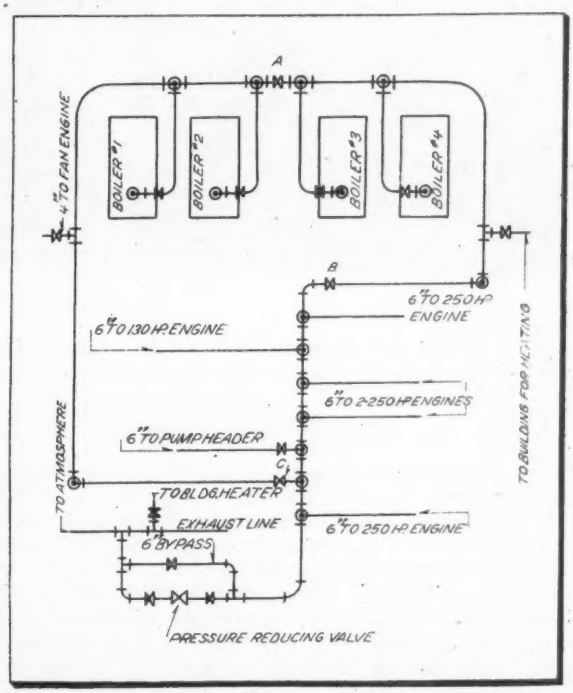
In the sketch, valve locations have been marked and the number kept as low as is consistent with good practice. By placing valves at A, B, and C, either battery of boilers may be used and the other shut down and its main closed in to save condensation. This would make a convenient arrangement for summer as I assume the fan engine is used for heating as is the line to distant building.

A valve should be placed near the main in the line to distant building, also one in the line to the fan engine unless it is located close to the main. A valve should be placed in each branch pipe from the boilers, general practice places them as close to the boilers as possible, care being taken that there is no chance for water to settle on either side of the valve. Valve in the line to pump header will be found convenient in case of repairs to header and a valve should be placed each side of the reducing valve in order that it may be shut off for repairs, one is also placed in the by pass.

Valves near the main in each of the lines to the engines, while not necessary are a great convenience in making repairs to throttle valves and engines. If the plant requires continuous operation, stop valves in each engine line are a necessity as the throttles will require grinding at times to prevent leakage. A valve should also be placed in the branch line from exhaust to building heater.

I should also like to comment on D. T. Crowther's answer to problems by J. R. on page 769 of Aug. 1 issue. Mr. Crowther states that he believes the most economical point to carry the water in a return-tubular boiler is high as possible without causing the boiler to prime.

My opinion is that a lower point would be more economical. I have always made it a practice to carry about 3 in. in the gage glass which, according to Massachusetts



LOCATION OF VALVES IN PIPING LAYOUT

standard, will give about 6 in. of water over the tubes. The advantages of this method are larger liberating surface for the steam, consequently a more rapid circulation with all the good features attending it, dryer steam and a larger volume to drain from.

I think these advantages more than offset Mr. Crowther's reason for carrying a high water level.

C. B. Hudson.

IN THE HEART OF THE CONTINENT

A Week of Engineering Study and Relaxation

IT ISN'T? OH, YES, IT IS. Take another look at the map. It's almost exactly half way between the east toe of Maine and the west shoulder of Washington, and between the gulf and the 48th parallel. And so Kansas City was a central and logical, as well as a hospitable and desirable city for the engineers' meeting ground.

And some 380 delegates came to the meeting, each representing 50 of his fellow engineers, besides an equal number of alternates, and almost as many accompanying ladies.

Kansas City welcomed all visitors, both engineers and exhibitors, with open arms, and having consideration of the comfort of its guests, said, "Take off your coats, roll up your sleeves and make yourselves at home." Then, with further consideration, moderated the temperature which was not at any time high as compared with that in other parts of the country, so that the last days of the convention were as delightful as could be imagined.

FIG. 1. DELEGATES AT KANSAS CITY

The Gathering of the Veterans

FROM Monday noon activity was vigorous. Many of the delegates were on hand for the first time and were experiencing novel sensations in the enthusiasm and earnestness of a great national gathering, and they were quickly initiated into the mysteries of committee meetings, caucuses, logrolling for office and other features which always accompany an important election. And the old friends were there in large numbers, also. The veteran of veterans, James G. Beckerleg, was on hand, as lively as any of the youngsters, and keeping him company in years of service were Stone from Boston, Cronley from Jersey City, Reitz and Mahon from Chicago, Heeger from Evansville, Jacques from Detroit, Schabacker from Brooklyn, Pratt from Cincinnati, and a host of others as well known.

From the very start earnestness was the keynote of the convention. While there was time for relaxation and diversion, even on the trips about the city and the casual chat in corridors and lobbies the talk was of the serious purposes of the Association, of the great progress made during the past year and the bright prospect for further advance in the future; all this reflecting the earnest and business-like administration of President Kearney. Following the fashion of the year, it was a Progressive Convention of Progressives, in education and engineering, and the results accomplished are evidence of this spirit.

As usual, the afternoon and evening of Monday were given to social intercourse and the formation of new acquaintances, and were well spent in this direction, as the delegates came to know each other and to understand the purposes for which they were gathered.

The First Session

TUESDAY morning the real work began, the Local Committee showing what it had done in the months of effort which it had put forth. W. F. Groom, chairman of the convention committee, called this preliminary meeting to order, as is the custom, and extended greeting after the musical numbers and invocation by Rev. Edwin B. Olmstead.

One of the striking features of this session was the appearance of Mayor Henry L. Jost as "3 in 1." Not only did he embody 2 "Excellencies" and 1 "His Honor," but in representing Governor Hadley he was appearing as a member of the G. O. P.; for Governor Stubbs he was a Bull Moose, and his Honorable Self was a Democrat, which in the present state of politics must be acknowledged as a comprehensive embodiment of views. In his address, however, he avoided any collision of his three egos and made all feel that they were indeed welcome to a great and grand city, which has been studying and solving problems in a unique and satisfactory manner.

Responding to this triple headed address, President Edwin H. Kearney expressed his appreciation and that of the delegates for the welcome, and sketched the beginning and the growth of the N. A. S. E. and outlined its present activities. As a preface to his address, a large portrait of President Kearney was unveiled, framed in the outside cover of the National paper, which brought hearty applause as a recogni-

tion of the great work that he has accomplished for the Association during the year.

Chairman Groom then introduced Ex-Senator J. K. Cubbison of Kansas, who commented on the importance of stationary engineers in the community and called attention to the fact that in the passenger elevators for which he furnishes power, the stationary engineer carries more passengers in a year than are carried by all the railroads in the country, and that upon the faithful care of this elevator equipment depends the life and safety of the passengers quite as much as those on the trains.

He spoke also of the progressive laws which Kansas has enacted for the protection of its citizens against their own thoughtlessness and the onslaught of unprincipled outsiders, and showed that Kansas has been a leader and pioneer in many of the reforms which are now being advocated throughout the nation.

Vice-President John F. McGrath replied, recognizing the progressiveness of Kansas and saying, "The history of Kansas, all within the memory of men now living, has been prolific with men who dared to do things because of their earnest convictions that they were right." He spoke of one of the famous men, John J. Ingalls, at one time a senator and presiding officer of the U. S. Senate, and author of "Opportunity," a poem which all should read. He referred also to Walt. Mason, of Emporia, as the greatest dyspepsia cure in the country, because of his cheer promoting stories and poems.

Referring to the matter of legislation, Mr. McGrath called attention to the effort of engineers to have states and cities provide for examining and licensing of engineers and the inspection of boilers, on account of the grave concern of the people as to the safety in installation and handling of steam plants. The N. A. S. E. is continually active in urging the passage of laws to cut down the inexcusable taking of human life, and the effort will be continued until the ultimate aim is accomplished.

In closing Mr. McGrath referred to the inventions and improvements that had been made during his 40 years of active service, and expressed the thought that possibly by the time some of the younger members had arrived at their final accounting, some members of the Association would have perfected a fireproof hydroplane, which would put Charon's boat out of commission and render the crossing of the Styx a quick and easy passage, robbed of all terrors.

John H. Atwood, following, gave an outline of the struggles and privations of the early days in Kansas and of the work which the pioneers did in winning the west. He called attention, also, to the same kind of work that is being done throughout the west at the present time by the energetic residents in bringing the resources of the vast country into subjection and in providing conveniences for living and for the transportation of those who may have occasion to come temporarily or permanently. The effort is so to solve these problems that all men shall have equal opportunity and fair play.

Responding to this address, Past-President Carl S. Pearse told of the work in his home state of Colorado in the development of power from the melted snows, and stated that more than $30,000,000 has been expended in utilizing the energy of the "White Coal."

At the conclusion of these preliminary exercises, Chairman Groom turned over the convention to President Kearney, who appointed committees for the work of the week, and then adjourned the session until afternoon. The audience passed out and went to the Convention Hall, where the official group photograph was taken, as shown herewith, and the exhibit of steam apparatus and supplies was formally opened by Vice-President McGrath.

FIG. 2. DELEGATES AT KANSAS CITY

From the opening of the sessions of the convention and of the exhibit, the harmonious and systematic co-operation of the National Officers, the Exhibitors' Committee and the Convention Committee, was evident. This had been brought about by a systematic division of the work; the National Officers arranging for the features of the sessions, the Exhibitors Committee for the raising of funds and the preparation of the exhibit, and the Local Committee for the local accommodations, meeting places and local entertainments. The benefit of this systematic co-operation was evident in the completeness of the plans and the smoothness with which all work of the week was carried out.

The President's Report

AT the afternoon session, the first order of business was the report of the National President, who stated at the outset that he would not infringe on the territory of the different committees, but would speak of his own work and give a brief summary of the work of the year. He told in a much more modest way than the actual facts warranted, of his work on a plan

of education and the establishment of a systematic policy and program for continuing the work, the Educational Committee appointed as advisors being Prof. E. F. Miller of the Massachusetts Institute of Technology, Prof. Joseph C. Riley of the same institute, and John W. Lane, Editor of National Engineer. This committee has given time and thought to the lay-out of a plan for the year and of policy for the coming years to the institution of new features for the educational work and to advising local associations at all times as to how they may best carry on their meetings.

President Kearney recommended that such an Advisory Committee be continued year after year, so that the program of the educational work may be continuous and the work of one committee may not be lost by an entire change of membership the following year. He advocated courses, shaped to meet the requirements of the greatest number, and graded to fit the experience of different members; also, the establishment of an Information Bureau for the answering of questions and the solving of problems.

He stated that the work for the past year had been somewhat experimental, feeling the way to make sure that the policies and methods were right, so that changes might not have to be made. He spoke of the introduction of educational features in the state convention programs, and the offering of prizes for the best papers submitted at state conventions, an offer which has resulted in the submission of some splendid papers to the Educational Committee. He advocated the expenditure of money to assist the weaker state organizations, believing that active and effective work by such organizations would encourage and strengthen every subordinate association within the state.

On the matter of license laws, President Kearney spoke of the advice which he had given to the License Committee, that careful investigation should be made in every instance where help was requested, to make sure that the State Associations and Local Associations are co-operating heartily in the effort to secure license legislation, before furnishing funds to assist. Every request for assistance had careful consideration along this line, and the conclusion has been reached that energetic and conservative action of engineers and associations will do more to secure the passage of laws than a lavish expenditure of money. In working for such laws, it is important to educate property owners and the public generally to the fact that such laws are for better protection of life and property, and that there is no underlying mercenary motive or thought of working a hardship on the owners of power plants.

Speaking of State Associations, President Kearney commented on the larger number of delegates in attendance this year than heretofore, the enthusiasm manifested, the better programs carried out and the larger exhibits in evidence. He expressed the opinion that the state conventions are here to stay and to grow.

He also stated that during the year propagation work had been carried on by means of state and as-

FIG. 3. DELEGATES AT KANSAS CITY

FIG. 5. THOSE WHO FAITHFULLY AND CLEARLY DEMON-

sistant deputies, and also by special deputies, the latter having proved particularly successful. The difficulty with state deputies has been to get attention to the matter from state and local associations, and the recommendation of suitable men early enough in the year to have appointments made and adequate work done. He recommended that such appointments be made as early as possible, and that state and local secretaries give the necessary information promptly, so that this might be done.

President Kearney reported, also, the design and adoption of an identification badge for use at the National and State conventions, having a facsimile of the front cover of National Engineer on the pendant, with the seal of the Association in the center of the page; the cross bar to have a space in which is to be inserted the name, number of the association and home address of the wearer.

He also spoke of the desirability of a historical compilation of the accomplishment of the Association during its 30 years of growth, and recommended that a committee be appointed for this purpose and allowed expenses of $50 a month for the work.

He recommended, also, that the National President be given full authority in all matters relating to arrangements for the national convention, the collection of funds and payment of bills, in order to avoid any friction with the committee of the Exhibitors Association or with the Local Convention Committee. He recommended in addition that cities asking for the convention be required to deposit a certified check for $2,000 with the National Treasurer, to be held during the year and returned when all promises made in regard to the convention have been fulfilled. This course was recommended in order to safeguard against poor memory, changes of city administration and other possibilities which might hinder the carrying out of promises.

The search for names of chief engineers in a canvas for new members was reported to have resulted in about 8,000 names, to whom descriptive matter and literature had been sent in regard to the principles of the Association, with the result that local associations had been benefited in the gaining of new members. Too short a time has passed to determine the entire gain as the result of this canvas, but sufficient has been accomplished to prove the advisability of such work.

FIG. 4. DELEGATES AT KANSAS CITY

President Kearney impressed upon the delegates the necessity for members to take an individual interest in the editorial and advertising columns of their technical paper, to get the most possible from its pages and to give it the largest possible share of growth and prosperity.

In making arrangements for the Kansas City Convention, President Kearney drew up and had signed a contract between himself and President Ashton of the Exhibitors Association and Chairman Groom of the Local Committee, defining the work of each, stipulating that the exhibitors were to furnish all funds for legitimate expenses in carrying out the arrangements, and that all bills contracted by the Local Com-

STRATED THE VALUE OF EXHIBITS TO ENGINEERS

mittee were to be approved by President Kearney. This is a business-like method of handling the work, and has resulted in satisfactory arrangements and avoidance of any disputes in making them. Besides it gives to each body the work for which it is organized and best fitted. The recommendation was made that this system be continued from year to year.

President Kearney announced that he had written a booklet to call the attention of steam engineers to the necessity of using up-to-date methods of securing information, and to show to engineers how the Association offers educational opportunities. 15,000 copies of this booklet will be printed and are to be ready for distribution from the National Secretary's office in a short time.

Summarizing his recommendations, President Kearney advises that an ambitious educational policy be pursued; that the Advisory Educational Board be continued from year to year, and that it be allowed a sum of not over $4,000 to expend during the coming year; that State Associations be encouraged by financial aid, and the awarding of prizes for educational work; that special effort be made to secure the passage of boiler inspection and engineers' license laws, and that financial assistance be given where a united effort is being made to secure such laws; that a Historical Committee be appointed, as already outlined; that the National President have absolute authority in national convention arrangements; that cities bidding for the national convention be required to deposit a certified guaranteed check for $2,000.

These recommendations were referred to the Committee on Analysis and Distribution for its recommendation.

Other Reports

VICE President McGrath presented his report as National Deputy, which showed associations instituted in Iron River and Muskegon, Mich., in Mankato and Albert Lea, Minn., in Paynesville, O., Charleston, W. Va., Peru, Ill., Great Bend and Parsons, Kans., Lexington, Ky., Los Angeles, Cal., Fort Dodge, Ia., Jersey City, N. J., Springfield, Mo., and North Bend, Oreg.; and that Associations have been reorganized in Jackson and Benton Harbor, Mich., Norwalk, Conn., and Ashland, O. The net gain in membership throughout the country has been 1,050, giving a total membership reported of 19,054.

Mr. McGrath deplored the system of the Association which requires state deputies to pay their own expenses in carrying out their work, and then to collect the money from the National Association after a lapse of several weeks, while the account goes to the national officers for approval. He recommended that deputies be allowed to draw a sum for expenses on a proposed trip which will nearly cover the cost, and then to present an account of money expended, with a requisition for additional expense that may have been incurred. He recommended the depositing of $500 each year with the National Deputy for this propagation work, money expended from it to be approved by the National Auditing Committee and the National Deputy to give a bond of $500 for the proper administration of the fund.

The report of National Secretary F. W. Raven gave in detail the gain and loss in each state, and the number of Associations in arrears and in good standing. He also showed receipts during the year of $29,410.98,

FIG. 6. THE EXHIBIT HALL FROM THE SOUTH END

and stock on hand of books, certificates, badges, etc., amounting to $1,354.90.

Report of National Treasurer S. B. Forse showed the amount received as indicated in the Secretary's report, the balance on hand September 1st, 1911, of $32,742.23 and interest of $500.93. The report gave a detailed account of expenditures for President's office expenses and travelling expenses, vice president's salary and expense, secretary's salary and expense, treasurer's salary and expense, and expenses of the trustees and deputies, mileage for delegates, hotel expenses, expenditure by Advisory Board and other miscellaneous costs, $28,731.25, leaving a balance on hand of $33,922.89.

Trustees' Report

IN regard to the growth of the National paper, the Trustees reported a prosperous year, both editorially and in a business way. Details were given in regard to the receipts and disbursements, and delegates were urged to give attention to the advertising pages of technical journals, because of the educational value to members and the information which can be had from advertisers. Also, co-operation with the editors was requested in furnishing articles describing interesting work and occurrences in their plants.

FIG. 6. THE EXHIBIT HALL FROM THE SOUTH END

License Committee

THE report of this committee showed active co-operation with state organizations throughout the country, and plans for prosecuting the work before the state legislatures during the coming winter. Bills have been presented during the year in New York, where the failure was due to lack of organized co-operation and to the existence of organized opposition to the bill. In Kentucky the bill was defeated in committee, but the work will be pushed forward for next year. In Maryland, although a bill was prepared, it was decided not to push this, after it had been defeated by the senate, although it was passed in the lower house. A bill will be introduced in the Illinois legislature during the coming session, providing for a chief commissioner and 8 district commissioners, plants under 15 hp. and with pressures under 15 lb. being exempted. The examination fee will be $2, and the renewal fee $2, required annually. In New Jersey active effort is being made, petitions are being circulated throughout the state requesting the signers to support only canidates who favor engineers license laws, and later a bill will be introduced in the legislature. In Ohio the attempt is being made to reduce the annual license fee of $2 and, if possible, to eliminate it on the ground that engineers should not be taxed for the privilege of following their vocation.

In Michigan a bill is proposed for submission to the next legislature covering a boiler inspection law and engineers license law, the supervision of the department being under the Commission of Labor. This bill provides for a Board of Boiler Rules of 4 members, representing boiler manufacturers, boiler owners, engineers and boiler insurance interests. The chief inspector, assistant and district inspectors are to be selected by competitive examination, the examination fee being $10. Ten general inspectors are to be appointed, and the fee for boiler inspection will be $5 for internal, and $2 for inspection while boilers are running. Engineers will be graded into 3 classes; the first, unlimited as to size of plant; the second, 100 hp.

and under, the third, 50 hp. and under. For steam heating plants where no machinery is in use, a boiler operator's license is required. The fee for examination is $1, and for the yearly renewal, $1.

Opposition to the license law bills has come from districts where steam plants are isolated from surrounding buildings, and from owners who did not appreciate the protective features. In some cases there was opposition from cities having local ordinances, the engineers not appreciating the need of universal protection.

The committee recommended that in working for license laws, the active co-operation of all organizations interested in power plants should be secured, and that, so far as possible, candidates for legislative offices be pledged to support such legislation.

In regard to the attitude of the National Commission on Uniform State Laws, report was made first unfavorably, and afterwards, on presentation of the reasons for uniform license laws, this unfavorable decision was reconsidered and a committee appointed to investigate the matter and to report next year.

Attention was called to the compulsory Workmen's Compensation Law, which has been enacted in several states and applies specially to those engaged in operating boilers, engines, heating, lighting, power and pumping plants. The main features of this law are the provision of 208 weeks' wages in case of death, as compensation to the dependents of the injured person, but in no case more than $3000, or less than $1000. For an injury resulting in total incapacity, payment is to be half the average weekly wages for a period of 10 years, but in no case less than $4, or more than $10 a week. For partial incapacity, the payment is to be one-half the difference between the average weekly wage before the accident, and afterward, this compensation to be not more than $10 and to continue for 6 years. Fifteen states now have such laws in force and giving general satisfaction. They protect the public against the throwing of injured persons on the state as a charge, and provide protection for the workers in case of personal injury.

FIG. 7. THE EXHIBIT HALL FROM THE NORTH END

Life and Accident Department

ANNUAL meeting of this department was held on the evening of Sept. 10, and the report of the Secretary-Treasurer showed 223 applications for new membership, all accepted but 3; that 34 claims had been presented and 30 paid, the total amount being $17,500. A few claims are still before the Board of Trustees for action. Certain changes in the by-laws were adopted, providing for medical examination of all applicants, the expense of such examination to be borne by the applicant; and for some changes in regard to the reinstatement of suspended members. The report showed an increase of over $1000 in the reserve fund during the year, and an increase in membership of 135. The election of officers resulted in the continuance in office of James G. Beckerling, as Chairman of the Board of Trustees, J. D. Taylor, as Secretary-Treasurer, and A. H. Kanaman of St. Louis, as Trustee for 5 years.

Wednesday

AT this session, the first order of business was the report of the Educational Committee, made by Prof. J. C. Riley of the Massachusetts Institute of Technology. He gave an account of the articles published calling attention to the necessity for studying operating costs in power plants, and advocating a general investigation on this subject. Papers presented as a result of these received prizes as follows:

The first prize to George F. Weaton, Pawtucket, Rhode Island; the second prize to E. S. Clark, Middletown, Ohio; the third prize to R. L. Ellis, Selma, Alabama; the fourth prize to Norman S. Campbell, Detroit, Michigan. Honorable mention was given to Waldo Weaver, Middletown, Ohio, and to G. L. Finch, Boston, Mass.

During the year classes on the use of the slide rule have also been advised by the Educational Committee, thus following the introduction of this important tool to the power plant engineer by Practical Engineer some years ago. Classes have been formed throughout the country, and the articles in Practical Engineer have been used by many of them as regular lessons. Prizes were given for the best educational programs carried out at state conventions, and were awarded as follows:—First prize to Illinois; second, to Wisconsin; third, to Colorado; fourth, to Iowa.

FIG. 7. THE EXHIBIT HALL FROM THE NORTH END

As a result of considering the problems of future educational work and of communications from different members, it was decided by the committee, first, that individual instruction by correspondence is not advisable for the Association, but that the best course is assisting subordinate associations to do the most possible for their members. This would include the offering of prizes for good work done by individuals; the encouragement of the study of technical papers, correspondence with such papers and study of the articles printed, and the laying out of a definite educational program for the year; the providing of a regular series of lesson papers with questions following; the awarding of prizes for the best sets of answers; the provision of lantern slides for illustrated lectures and of notes to go with these slides which will serve as outlines for talks by members specially well posted; the provision of a list of subjects and lecturers available in various parts of the country; and the maintaining of an Advisory Board to act in a consulting capacity and answer questions of members. Prizes should also be awarded to associations which hold especially instructive meetings, at which a large proportion of the members attend.

In the matter of lantern slides, it is proposed to have several sets deposited at central cities, such as Boston, New York, Cincinnati, Chicago and Denver, these slides to be loaned to any association on the depositing of a fee, which fee will be returned after the slides have been actually used and returned in good condition to the custodian.

In the contest for gain in membership, prizes offered by President Kearney were awarded as follows:—The first prize, a steam engine indicator, to Ohio No. 21 of Lima; the second prize, an indicator, to Missouri No. 7 of Kansas City; the third prize, a gage testing outfit, to Pennsylvania No. 15 of Pittsburgh; fourth prize, a planimeter to Pennsylvania No. 3 of Pittsburgh.

Committee Recommendations

IN its report on the President's recommendations, the Committee on Analysis and Distribution endorsed his views and the work that he had done during the past year. They advised that all his recommendations be adopted, and later on in the convention this was done. They advised also that, at the expiration of the present publishing contract, the Association take up the work of publishing the paper itself, and that a special committee of 3 be appointed to consider such a change and report at the next annual meeting.

A resolution was introduced in regard to the assisting of engineers in isolated plants who were having difficulty because of the competition of central stations,

and empower association officers to give financial aid in such cases, in the opposing of central station encroachment. At the Thursday meeting this resolution was reported on unfavorably, but, after considerable discussion in which the methods pursued by some central station companies in regard to discrimination in rates and the taking of contracts below the actual cost of production in order to drive out isolated plants, had been described, the Association approved of the resolution and voted that the officers should render such financial assistance as they might think best.

Following this work, Prof. Riley gave an interesting lecture on the relative action of steam and gas in an engine cylinder, comparing the indicator diagrams, proper and improper valve action, and especially on points which should be taken up carefully in operating the gas engine.

Relaxation

ADJOURNMENT was taken early from the Wednesday session, in order that the delegates and guests might be ready for the afternoon outing at Fairmont Park. After a trolley ride of some 8 miles through the pleasant suburbs of Kansas City, the park was reached and a Dutch luncheon served by the courtesy of the Local Committee. Later the facilities of the park were at the disposal of the engineers; bathing, boating and other amusements being available. A ball game was played between the engineers and exhibitors, at which unexpectedly, in a 4-inning game, the exhibitors won with a score of 16 to 3. A number of races, which were more energetic than athletic, were run off, the time not being taken in any event, as no one had an 8-day clock with him. The remainder of Wednesday afternoon and evening was spent in visits about the city.

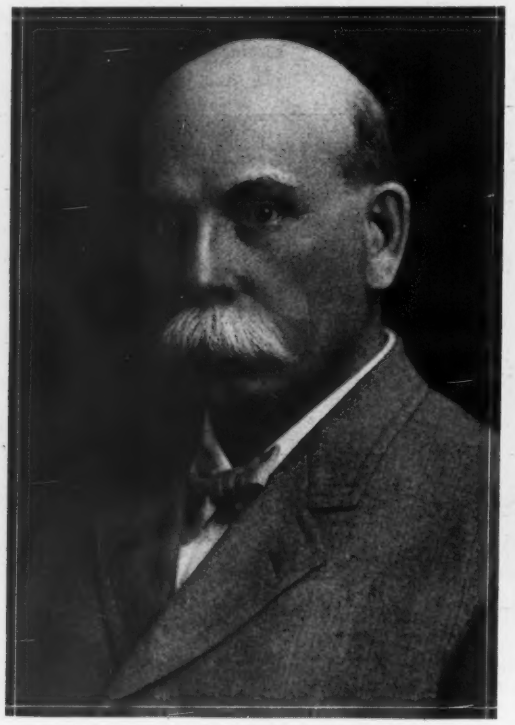


FIG. 8. PRESIDENT JOHN F. McGRATH

Important Legislation

ON Thursday morning the reports of committees were taken up for action and all recommendations of the President and of the License Committee were adopted. The recommendation of the National Deputy to provide an expense fund for State Deputies was, however, disapproved. By the favorable action taken, a large fund is made available for the pushing of educational work, and a definite plan of action for future years which will take advantage of work already done, is put into practice. This is bound to tell in efficiency of the organization and in progressive work, as every point of advantage gained will be held and added to, instead of a fresh start being taken each year.

Some question arose in regard to the distribution of surplus funds left in the hands of the Cincinnati Local Committee, and it was finally decided that this should be returned to the donors. At Cincinnati a vote was passed that jewels should be provided and presented to Ladies Auxiliary, and President Kearney announced that this had been done and a letter of thanks was received from the officers for these jewels.

FIG. 9. VICE-PRESIDENT JAMES R. COE

Memorial Service was next in order, and the names of departed members was read by National Secretary Raven, after which a musical number was rendered by the quartette and a silent tribute of respect paid to the dead.

Matters taken up at the afternoon session were the report of the Ritual Committee, that no changes be made, which was approved; the receipt of 9 proposals to amend the constitution, which will be submitted to referendum vote, and the resolution in regard to central stations and isolated plants already described. The remainder of the afternoon was taken up by an instructive lecture on Modern Factory Il-

lumination, delivered by J. G. Henninger, of the Buckeye Electric Co., of Cleveland.

Resolutions and Elections

AT the Friday morning session 2 important actions were taken; the first, authorizing the formation of district associations and the issuing of charters where there is not sufficient membership of subordinate associations in one state to warrant a state association. The district association will include a group of adjacent states banded for the purpose of co-operation and holding district conventions.

The second resolution was for the appointment of a committee to consider the matter of biennial conventions rather than annual, the State Conventions to take the place of the National Convention in the off year, and the money saved from the National Convention expense to be available for educational work in the state and local associations.

Officers of the Ladies' Auxiliary and of the Life and Accident Department were received at this time and addressed the convention, thanking the delegates for their co-operation and telling of the pension work and of the benefits which are derived from membership in the Life and Accident Department.

A vote was passed to allow the Secretary and Treasurer $25 a month extra expense account, and resolutions were adopted thanking all who had contributed to the success of the convention.

The membership prizes were delivered to the representatives of the organizations which had won them, and the convention passed to the selection of a meeting place for 1913. After some discussion and oration, Springfield, Mass., was chosen, the general understanding being that the 1914 Convention will probably be held in Detroit, and the 1915 in San Francisco in connection with the Panama Exposition.

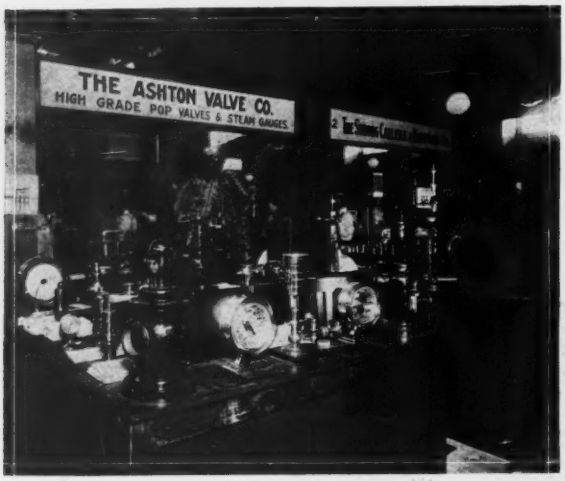
Election of officers resulted in the choice of John F. McGrath, of Chicago, as president; James R. Coe, of New York, as vice-president; F. W. Raven, of Chicago, as secretary; S. B. Forse, of Pittsburgh, as treasurer; W. J. Reynolds, of Hoboken, N. J., as trustee for 5 years; Geo. A. Camblin, of Denver, as conductor, and F. W. Fischer, of Knoxville, Tenn., as doorkeeper. This completed the routine business of the convention and adjournment was taken until evening, when the officers were installed preliminary to the holding of the annual reception and ball.

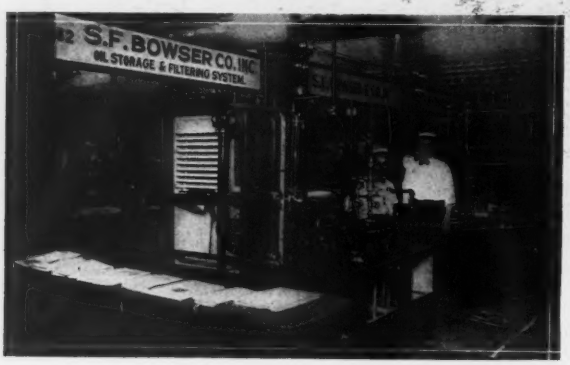
FIG. 10. OFFICERS OF THE EXHIBITORS ASSOCIATION. FROM LEFT TO RIGHT, UPPER ROW, PAST PRESIDENT HARRY ASHTON; EXECUTIVE COMMITTEE, JOHN H. FOOTE, CHAS. A. WILHOFT, PAUL PAYNE, CHAS. CULLEN, HARRY D. RAYMOND; LOWER ROW, SECRETARY HENRY A. PASTRE; VICE-PRESIDENT HOMER WHELPLEY; PRESIDENT M. B. SKINNER; TREASURER J. M. CHAPMAN

EXHIBITORS' ASSOCIATION MEETINGS

A REGULAR meeting of the Exhibitors' Association was held on Monday evening, Sept. 9, when the reports of committees were received and acted upon and various matters were brought up for discussion. There was, however, no change in methods of operation decided upon except that all candidates for office were to be put on one ballot and marked by crosses, according to the Australian system.

Election of officers was held on Thursday, between 10 and 12 a.m., and resulted in the choice of M. B. Skinner, of James McCrea & Co., Chicago, as president; Homer Whelpley, of Strong, Carlisle & Hammond Co., Cleveland, as vice-president; Henry A. Pastre, of Elliott Co., Pittsburgh, as secretary; J. M. Chapman, of Crandall Packing Co., Palmyra, N. Y., as treasurer; and for executive committee members, John H. Foote, of McLeod & Henry Co., Troy, N. Y.; Harry D. Raymond, of A. W. Chesterton Co., Boston; Charles A. Wilhoft, of New York Belting & Packing Co., New York; Paul Payne, of Dearborn Drug & Chemical Works, Chicago; Charles Cullen, of Wm. T. Powell Co., Cincinnati. A final meeting of the Association was held on Friday, at which the election of officers was announced, the new officers were installed and a handsome diamond ring was presented to the retiring president, Harry Ashton, as an expression of the appreciation of the fine work that he had done, the presentation speech being made by F. R. Low.





On Thursday evening the exhibitors provided in the Convention Hall a program for the entertainment of the delegates, which was thoroughly appreciated by all who were fortunate enough to be in attendance. The numbers, which consisted of songs, monologs and specialties, included William Murray, of Jenkins Bros.; John J. McDonald, of W. B. McVicker & Co.; Fred S. Hickey, of Dearborn Drug & Chemical Co.; Kenneth G. Merrel, of James McCrea & Co.; Jack Armour, of Hill Publishing Co., and Joe Kelly, of Perolin Co.

The exhibition in the Convention Hall is described in detail and illustrated by photographs herewith. The committee is certainly to be congratulated heartily on the impressive exhibit which was gathered in a city somewhat distant from the usual centers where conventions have been held. It was a tribute to the hard work and enthusiasm of the committee, and the pleasing decorations and arrangement of booths, as well as the convenience of all arrangements for exhibitors, was appreciated by those who had to do with the exhibit work and by the visitors to the exhibits. A good attendance of interested visitors made all who were present feel the trip had been well worth while.

Every Victor talks by it, for the worm of each Victor talking machine is lubricated with No. 4X Philadelphia Grease, the kind exhibited by Horace A. Smith for the Philadelphia Grease Mfg. Co. of Philadelphia, Pa. This, the "quality lubricant," comes in 8 grades, from solid to liquid, for all purposes.

Split metallic ring packing for all sizes of rods up to 16 in. diameter were shown by the C. Lee Cook Mfg. Co. of Louisville, Ky. Robert C. Baldwin, secretary of the company, explained the use of the cast-iron split rings held in place by garter springs for true rods, and the split

bevel babbit rings closed by wedge rings and endwise spring pressure for irregular and vibrating rods. The "big fellow" was for a 16 in. rod on a rolling mill engine, and had serial coiled springs to reduce the length.

The stars were shining in the booth of the Wm. Powell Co. of Cincinnati and Chas. Cullen kept them so, with Jimmy Coombe to help. In the constellation were the Powell nickel seat White Star, the Model Star, the Union Disc in all sizes and types, with a full assortment of brass specialties to fill in the spaces and pyramids of White Star discs and seats to frame the picture.

Representing the National Engineer were Robert W. Larkin, John Lane and W. T. Mugg.

Everything for pipe lines, including packings, coverings, gaskets, and many things for other parts of the plant, including J. M. Sea Rings for rods, J. M. boiler preservative and Vulcabeston pump valves, were exhibited by the H. W. Johns-Manville Co. of New York in charge of B. C. McClure, who was assisted by P. J. Harrington and W. S. Nicholson. The packings included Permanite black sheet, Duplex red core, Universal nonvulcanizing with red cushion, lubricated throughout, Aqua white, Hydro waterproof, Kearsarge ring and spiral, split metallic.

The whole Rainbow Family was present with the Peerless Rubber Mfg. Co. of New York, including sheet, spiral, square, round and gasket. Besides there were the Wizards, red sheet for superheat and high pressure, plumbagoed for globe and angle valves, and the various other brands of packing, hose matting and tiling which the Peerless Co. and its western representatives, Geo. B. Carpenter & Co. of Chicago, furnish in bewildering variety and completeness for all mechanical purposes for which rubber is used. Stephen Roberts, in charge of the exhibit, and Chas. Heinzmann and C. F. Von Gyso introduced old friends and new to their numerous charges.

The old friends, Palmetto and Manhattan, from New York, were round as usual and square as ever at Greene, Tweed & Co.'s booth. They were just packings, but had able spokesmen in F. E. Ransley, B. M. Bulkley and L. J. Van De Wall, who insisted that you should "stick to a good thing."

If anything needs regulating or reducing there's a Mason device for it, and the Mason Regulator Co. of Boston, Mass., makes it. Reducing valves, damper regulators, pump governors, pressure regu-

lators, all were exhibited in sectioned samples so that the working mechanism could be readily studied and understood. And the representatives, F. A. Morrison and G. U. Poole, were always ready to help in assisting such study.

It let all the water out, but no air. It was a Squires trap working on 50 lb. air pressure to show that no steam gets by it when in service. There was also shown at the exhibit of the C. E. Squires Co. of Cleveland, O., an office desk demonstrating outfit worked by a hand pump and operating as perfectly as the full size trap. J. G. Boyer did the demonstrating.

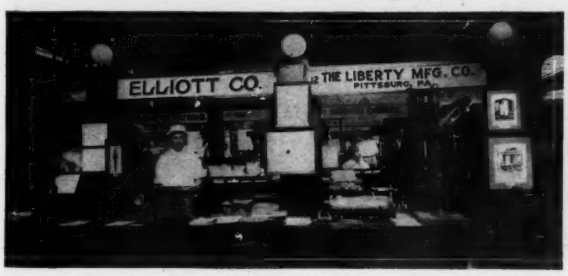
"Without halting, without rest, pushing better up to best," is the motto of the Kent Lubricating Co. of Milwaukee, Wis., which exhibited Kent greases for all purposes and Utility grease specially for street car motor journals, in charge of Lawrence H. West.

Four Corliss Valves, positively driven, with double ports, quick action and inserted cage steam valve seats were the features of the model valve motion shown by the Ridgway Dynamo and Engine Co. of Ridgway, Pa. Detail parts were also included and the points explained by R. C. Eccleston, P. G. Rimmer and W. F. Grooin.

A complete Steel Mixture boiler setting, including the special fire door arches, regular blocks and the Foote back arch was shown in place on a small boiler by the McLeod & Henry Co. of Troy, N. Y. The metallic ring of the Steel Mixture blocks gave the reason for the name as well as indicating their steel-like qualities. John H. Foote was in attendance as usual, with J. Spencer as assistant.

Garlock styles, sheet packings, braided metal, flax and graphited and a whole line of squares, rounds, rings and disks, with moulded gaskets besides made up the exhibit of the Garlock Packing Co. of Palmyra, N. Y., in charge of T. M. Green, J. E. Hillerman and H. P. Crowley.

Jenkins Bros. received their guests in the fernery, where were arranged the Jenkins valves in all styles and sizes, Jenkins discs, '96 and Jenarco sheet packings, cut and Jenkins tubular gaskets and the line of Jenkins' heating specialties which were distributed by



Frank Martin, H. B. McLelland and F. G. Jolley. The new line of gate valves in bronze, iron and steel bodies for standard, medium and extra high pressures was especially interesting.

The Victor does it; that is, regulates temperature, as was shown by the control which opened and shut off with ½ deg. change in temperature in the exhibit of the Standard Regulator Co. of New York. Other Victor regulators are for pressure for hot water, for dampers, for fan engines, for draft pressure and what not where regulating is needed.

Rex, Kymoi, Plox, not mystic pass words, but brands of packing which with many others made up the line shown by the Crandall Packing Co. of Palmyra, N. Y. Representing the company were J. M. Chapman, G. W. Anderson, H. N. Hubert and Mr. Page.

For Power there were present F. R. Low, J. W. Armour and H. R. Anness.

Either compound from special analysis or made up to suit average requirements, the Western Boiler Compounds in liquid, paste or powder form or Western Graphite treatment are furnished by the Western Boiler Compound and Chemical Co. of Kansas City, which also supplies the compound feeders with which to administer the remedy. Representing the company were: F. Joe Dady, A. Kroner, M. Barter, Jesse Barter, A. E. Wianand and Ed Cuthbertson.

"The chart tells the story" of the water which passes the Venturi hot water meter, for the recorder which the meter operates makes the chart. And both are made by the Builders Iron Foundry of Providence, R. I.; represented by W. D. Hess of Chicago.

Good American products of the American Steam Gauge and Valve Mfg. Co. of Boston as shown by Charles C. Kilander and Louis W. Repsold included recording gages, dead weight testers, whistles, American-Thompson Improved Indicators, safety valves and the American H_2O

grease extracting feed-water filter for insuring that the return to the boiler is free from grease, sediment and suspended matter.

Scale from boiler plates, scale from boiler tubes, and pipes with scale deposits were shown as "horrible examples" of the conditions which Arrow compounds will remedy by E. M. Swindle and W. H. Fairlamb of the Arrow Boiler Compound Co. of St. Louis.

All Swartwouts, hence, already for business, those specialties made by the Ohio Blower Co. of Cleveland, and explained by E. N. Walton. They included the Swartwout centrifugal steam and oil separator, the Swarwout cast-iron exhaust head, and the Swartwout rotary ball bearing ventilator.

It clings to the belt, as was proved by the belt treated in 1901, not treated since, but still soft and flexible with fine surface. And Cling-Surface makes the belt cling to the pulley, as proved by the traction model showing the pull of a treated and an untreated belt of the same size and under the same tension. Also by the photographs of Cling-Surface belt running slack and pulling heavy loads. It's good for rope, too, as explained by W. D. Young, secretary of the Cling-Surface Co. of Buffalo, N. Y., and his assistant, F. J. Rhoades.

Pure graphite for boilers is the scale remover and preventive prescribed by the United States Graphite Co. of Saginaw, Mich. The Mexican graphite, as it comes from the mine in big lumps, and the powdered form as furnished for boiler treatment and lubricating purposes, were the feature of the exhibit, surrounded by an attractive background of roses and palms. J. L. Stewart, F. S. Pritchard and W. C. Skaden explained the why of graphite treatment.

Perolin from Germany was well advertised by the Perolin Dutch Boy, who industriously tagged all present with his likeness. Careful German exactness was characteristic of his work as of the product which he

represented, and nobody was skipped. Representatives of the Perolin Co. of America, Chicago, which makes the Perolin compounds, were Charles M. Viley, Fred McGervey, and H. E. Moss.

Home Rubber Co.'s familiar brands, O. I. M. and N. B. O., were well displayed by A. R. Foley.

Elevator Lubricants, each for its own particular job, were shown by the Otis Elevator Co. of Yonkers, N. Y. Requirements of the different bearings have been carefully studied and met by lubricants for motor bearings, for worm gears, for cups, for buffers, for rope, for guides; and even a cooling oil for magnet cases. A special ball case and disks for a thrust bearing was shown which has overcome screw thrust troubles. Chris. Neilsen and Ludlow Shonnard explained the details.

Elevator cables, hoisting rope and transmission rope were shown by John A. Roebling's Sons Co. of New York, in charge of F. Hinterberg and J. Troescher.

Vacustats for air lines, nonadjustable, with big opening, expanding disk and carbon post, the Thermostatic return line trap with the same

big discharge area and expanding diaphragm and ball seat and other devices used in the Reliable vacuum heating system were shown by the Bishop-Babcock-Becker Co. of Cleveland, O. C. McCann explained the operation of the system and the application of motor driven pumps for large plants and water pressure motors for smaller and residence work.

For refrigeration Nonpareil cork board and pipe covering and for steam lines Nonpareil high-pressure coverings were recommended by the Armstrong Cork Co. of Pittsburgh. The corkboard was shown made into sample sections of walls for refrigerating rooms, and the pipe coverings in moulded forms for pipe from 1½-in. up to 36-in., as well as in slabs and cement for special use. C. G. Lauck and J. Y. Beard were the insulation experts.

For Lubricating, for belt dressing, for pipe joints and for boilers, use flake graphite in grease or dry form. Special forms for special uses. This advice and the reasons why were fully given by Arthur King and L. W. Brooks, acting for the Jos. Dixon Crucible Co. of Jersey City, N. J.

They set a trap, a sectioned Model D for everybody to look at, and examine the action of the "fool proof" valve, pull it apart and put it together as much as they liked. Notable features in this trap made by the V. D. Anderson Co. of Cleveland, O., were the valve and seat removable from the outside without disconnecting any pipe and with no

tools, absence of screws or bolts on the inside of the trap, and the renewable valve and seat at slight expense. Jos. H. Meyer and H. H. Van Derzee were telling about these features.

"It will stop the pump," that is, when the pressure has reached the right amount. The Fisher pump governor is one of the regulating devices made by the Fisher Governor Co. of Marshalltown, Ia., represented at the exhibit by Geo. H. Beebe, Jasper Fisher and Jacob Eige. The governor will regulate for pressures from a few ounces up to 10,000 lb. per sq. in. Other Fisher devices shown were the reducing valves, vertical and inverted relief valves, back pressure valves and vacuum pump governor for heating systems.

Babbit metals, Rogers special, Rogers nickel, extra, Star Nos. 1 and 2 and motor bearings were shown by the Rogers Metal Works of Kansas City, represented by Paul O. Rogers. These have an antifriction surface with grain specially adapted to carry a heavy oil film.

Pressure regulated as desired and held constant, for either steam or air, and the exact "how" of this exact device was shown by the sectioned Ohio Pressure Regulating Valves in the exhibit of the Ohio Brass Co. of Mansfield, O. Other specialties shown were the Ohio water gage, chain operated, and the Ohio weight self-closing gage cock with a babbit metal valve adjusted by a "twist of the wrist." W. T. Jamieson and C. E. Young acted as hosts at the exhibit.

Wm. W. Nugent & Co. had a double space, but no exhibit.

Inspection and Insurance of boilers and furnishing bonds for inspectors and officials is the business of the Missouri Fidelity and Casualty Co. of Springfield, represented at the convention by J. H. Chesnutt, H. P. Bowman, J. L. Hart, W. A. Vincent and A. A. Werner.

When the fuse blows, if it's enclosed and puts out the arc, little harm results. Then if it's easily and properly renewable, replacement is easy and inexpensive. Just how the Economy renewable cartridge fuses accomplish this result was explained by A. L. Eustice, A. E. Tregenza and M. B. Urquhart of the Economy Fuse Co. of Chicago.

The Revere roof garden booth, attracted, then rested, then instructed. Pillars and roof frame of Revere hose coils "in any length" were covered with "asters and flowers" and the parlor below was gay with flowers and didactic with rubber goods. Black Hawk ring, spiral and sheet; Paramo sheet and a big roll of Giant belting. The "gardeners"

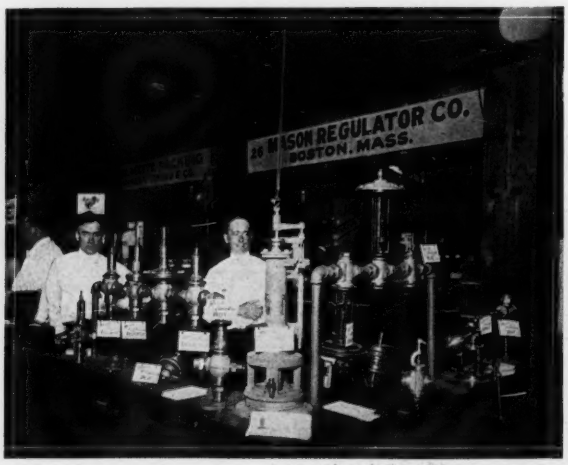
were F. B. Williams, J. W. Dudgen, F. E. Belcher, Robert M. McCallan, Roy J. Hanna and Walter H. May.

The Morehead. That was the sign and apparently it was "'nuf ced" for the traps spoke for themselves and Chas. Menges did the rest. There were 800 gal. an hour traps, a condenser trap for the low pressure systems and a boiler feed trap for high pressure, and a book to explain details of the single trap and double trap systems of the Morehead Mfg. Co. of Detroit, Mich.

Rope was not just a bundle of wires at the exhibit of A. Leschen and Sons of St. Louis. But after talking with F. N. Chapman or W. B. Leonard ropes had individuality and characteristics according to the intended work; flat strand, flexible core, lock coil, each meant a kind and a reason.

Pump slip low, fuel consumption lowered valve wear lowest with the Hill pump "valve which seats itself," was the story told by Robert B. Orr and Mr. Wade of the Hill Pump Valve Co. of Chicago and they gave facts and figures to prove that the metal back does the work.

Coke the coal on the center cone and burn the coke on the flat



outer grate is the process of the Nicol Smokeless Grate Co. of Kansas City. T. W. Nicol and E. L. Nicol made details clear by a model grate.

Clean oil and plenty of it prevent bearing troubles, and the illustration of how the Bowser Central oiling system gives this was worthy of the close attention given to the exhibit of the S. F. Bowser Co. of Ft. Wayne, Ind., in its 3 booths. The apparatus demonstrated by a system in operation the working of the filter, the feed line and cup connections, and the return lines and dirt traps. Small filtering outfits and oil cabinets were also shown and the advantages demonstrated by H. E. Dobson of the New York office and W. A. Armstrong.

Complete feed water purifying, treating, heating, measuring and recording were shown in the 500-hp. Cochrane outfit exhibited in operation by the Harrison Safety Boiler Works of Philadelphia, Pa. This system includes in one apparatus, a back pressure valve, oil separator, treating device, settling tank, flow recorder, instantaneous flow indicator and chart mechanism, giving a compact unit for the entire installation. Harvey B. Mann and R. B. Jones were in charge.

Representing Clement Restein Co. of Philadelphia and exhibiting the complete line of Belmont packings, the Gustin Bacon Mfg. Co. of Kansas City laid special stress on the "Story of a Hole," the packing with a hollow center, which center weighs nothing and allows for expansion. E. N. Marcy represented the Restein factory and C. L. Miller the distributing firm.

As many feeds as desired was illustrated by the Hills-McCanna 20-feed force feed lubricator seen at the booth of the Hills-McCanna Co. of Chicago, which was in charge of Robt. E. Hills. For this and the other lubricators with fewer feeds the claims were a simple ratchet pump with feed adjustable from heavy to slight while running, outside valves and operating mechanism, positive sight feed and heater connections where needed. Besides the lubricators were shown the combined low water alarm and fusible plug, swing joints for oil or grease lines and high-pressure gage cocks.

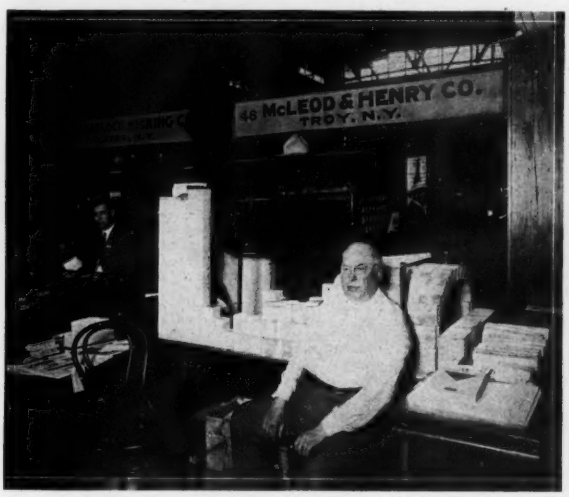
It ran right through the convention and everybody stopped to see it. It was a "truly" Corliss engine, though small, yet as sturdy, dependable and economical as its big brothers. The little Murray catalog was also complete in every way and as attractive as the little engine. Both were from the Murray Iron Works of Burlington, Ia., represented by W. M. Jones, W. O. Everett and Mr. Hunt.

The Spiro turbine, what it is and what it can do, were graphically illustrated by the Buffalo Forge Co. of Buffalo, N. Y., with a plant in

which a No. 1 turbine which would almost go in a stove pipe hat, yet busily drove a generator that lighted 65 15-watt tungsten lamps, and a No. 2 turbine which rates at from 1 to 3 hp. and was direct connected to the Buffalo centrifugal pump that fed the waterfall. The inventor of the Spiro, John H. Van Deventer, gave full information and J. F. Henning watched the plant run, which was about all the attention that it needed.

In packings and belting the New York Belting and Packing Co. made attractive display of its usual complete line. Most prominently displayed was the Indestructible White Sheet guaranteed for steam, oil, ammonia, naphtha, benzine and creosote; besides this were the Ruby sheet, and the Firo sheet for superheated steam. In rod packings, the Cobbs, Vulcan and Crocoit were shown and the Turxo for valve stems. Chas. A. Wilhoft of New York, manager, was in charge of the exhibit, assisted by F. E. Friedlander, Edwin Soph, J. L. Ward and R. C. King.

Elliott steam specialties included a 2-in. twin filter and grease extractor, with chained washers and oversize bolt holes, a 14-in. back



pressure valve, a single filter, steam and oil separators, steam traps, blow-off valves, feed-water regulator, water columns and twin strainers. The representative of Elliott Co. was Henry A. Pastre of Pittsburgh.

For The Liberty Mfg. Co. of Pittsburgh, F. J. McDevitt demonstrated the latest type of Liberty air driven tube cleaner and a complete line of water, steam and air driven cleaners, tube expanders, cutters, etc.

All Kewanees, the unions and union fittings "with no inserted parts" were used in making the sign Kewanee Specialties shown by the National Tube Co. of Pittsburgh. Another feature was the line of National regrinding valves of all types. "They last," was the special recommendation. A guessing contest on the weight of the exhibit rewarded the winner with a fine walrus traveling bag. The company's representatives were L. F. Hamilton, P. F. Bart and Raymond Redden.

In the guessing contest, the bag went to Frank Urich of the English Tool and Supply Co. of Kansas City, who estimated 3518 lb., the weight of the exhibit being 3520 lb.

A complete Heine boiler plant in model with setting and superheater was shown by the Heine Safety Boiler Co. of St. Louis. The model showed the exact construction of all parts of the boiler and superheater and full size details of tubes, headers and caps were also shown. "Boiler Logic" and "Superheater Logic" were the books that told about it and were presented to visitors by C. R. D. Meier, president of the company and Walter Springe.

A Strong stop stops the engine when a quick stop is needed, either automatically from overspeed or a frayed rope drive or by button from long distance in an emergency. The details of the action were shown by the full size stop exhibited in operation by Strong, Carlisle and Hammond Co. of Cleveland, Ohio. Other specialties were the Strong feed-water regulator and Strong pressure regulator. Secretary Homer Whelpley and C. M. Belding were the representatives.

Thirty-five kilowatts was the capacity of the direct-current turbo-generator unit in the space of the Westinghouse Companies of Pittsburgh. It was for delivering 200 amp. at 125 volts and at a speed of 4000 r.p.m. The Westinghouse air compressor was 9½ by 9½ by 10 in. and a set of nozzles for air cleaning about a plant was shown with it. M. H. Burchard, S. H. Mills and G. S. Carrick explained the action of the machines.

Instruction by Correspondence, with illustrated lessons and literature on all subjects, formed an attractive display in the booth of the International Correspondence Schools of Scranton, Pa. Mr. J. D. Jones was in charge, assisted by Messrs Reid, Sears, Hanford and Gould.

Mechanical Exhibits always attract attention and when the temperature sticks around the melting point an Ice Making Machine looks particularly interesting from more than one point of view. So thought the crowds that kept Mr. Jackson, assistant refrigerating engineer of the Andiffren Refrigerating Machine Co. busy explaining the working features of the small machine which was in operation at the Johns-Manville Co. booth.

"The valve that never sticks," is the slogan of the Bradbury Blow-Off valve, manufactured by the English Tool Supply Co. of Kansas City, and Mr. Urich and Mr. Pensinger were busy explaining the features of this new device to many interested delegates.

France Metallic sectional packing was the feature of the France Packing Co. of Philadelphia exhibit, and its virtues were willingly extolled by A. W. France. Metallic packing for hydraulic service and for ammonia and gas engines was also shown.

Four busy men presided at the booth of the Consolidated Engineering Co., Chicago, where a full line of this concern's specialties were on display. The devices shown included Belvac Thermofiers, Back Pressure Valves, Vacuum Pump Governors, Pressure Regulators, Settling Chambers, Oil Traps, Coenco Steam Traps, Automatic Pump and Receivers and Thermo Control System Valves. Messrs. Wade, Meltsow, Doeffler and De Lanney did the honors.

Hawk Eye Compounds were much in the limelight, due to the able manner in which H. E. Tibbles and J. G. Trimble explained the merit

of this company's method of water purification. Some useful souvenirs were distributed to visitors by the Hawk Eye Co. of Chicago.

H. E. Wallis of the Hawkes Boiler Co., Chicago, must be some fireman. In the working model of the boiler, he not only kept the pressure up at all times, but had enough energy left to explain every detail of his machine to a never ending crowd of visitors.

No-Koros Unions, Compression Disc Unions and Malleable and Cast-Iron fittings were on display at the booth of the Illinois Malleable Iron Co., Chicago, which was in charge of E. M. Marshall.

In addition to having a most attractive booth, the Dearborn Drug & Chemical Works of Chicago had a corps of industrious representatives looking after the company's interests and, incidentally, the pleasure and comfort of all delegates and visitors. The Dearborn method of treatment evidently is not confined solely to the handling of boiler feed waters. Included in their list of hosts were Dan Delaney, P. H. Hogan, J. G. Beckerleg, I. H. Collar, Fred S. Hickey, W. S. Weaver, Frank Eardley and Paul T. Payne.

Detroit Grease is made in seven consistencies, according to the statement of Silas C. Cook, manager of the Grease Department of the White Star Refining Co. of Detroit, Mich. And he backed up this statement by showing samples of the grease in its varying forms, each intended

for a special class or kind of lubrication. Mr. Cook will be remembered by many as having represented Adam Cooks Sons for several years and his numerous friends wish him well in his new connection.

Boiler room appliances in various forms were on display in the exhibit of G. L. Simonds Co. of Chicago, and Messrs. Moreland and Fox obligingly explained the merit of each device to the interested delegates. The line included Vulcan Soot Cleaners, The Hays Flue Gas Analysis Instrument, Eclipse Smoke Indicator and Dean Boiler Tube Cleaners.

The Hayes gas analysis apparatus offered by the G. L. Simonds Co. was awarded to C. A. Meyer, chief engineer of the Naval Gun Factory, Wasaington, D. C., and the Vulcan soot cleaning outfit to W. H. Cronley, chief engineer "Bill" of the city hall, Jersey City, N. J.

An Indestructible Gasket that is absolutely **blow proof** must be a pretty good gasket. That's what D. S. Paterson says about Flexitallic Gaskets, and he ought to know, for he is the sales manager of the Flexitallic Gasket Co. of Philadelphia and he backs up his claims by offering to let any engineer try one or more of them in his own plant.

Stopping an Engine automatically or by pushing a button anywhere in the plant is a simple but certain operation, says J. H. Raymaker of the Falls Machine Co. of Sheboygan Falls, Wis., providing you have installed a "Falls" Automatic Engine Stop and Speed Limit Device. With the assistance of a life size working model as a demonstrator, there was no chance to dispute the claim.

Mining and Engineering World was represented by J. Winchester Holman.

Hydroil and Tauril sheet packings were the main features of the exhibit of the Anchor Packing Co. of Philadelphia, which also included

a complete line of fibrous packings, pump valves and asbestos gaskets. The booth was presided over by Mr. Philp of the Omaha branch and Mr. Swain of the Chicago office.

Reeves & Skinner Machine Co. of Kansas City displayed products of Jas. Beggs & Co., New York; Goulds Mfg. Co., Seneca Falls, and the Alberger Condenser Co., New York, whom they represent as local agents. E. B. Rhea was in charge.

Southern Engineer, Atlanta, Ga., represented by W. R. C. Smith and F. J. Whiteside.

Descriptive literature, showing the construction and operation of the Jones Underfeed Mechanical Stoker, was distributed at the booth of the Underfeed Stoker Co. of America, which was in charge of W. T. Johnson, assisted by C. K. Sherman and C. G. Sherman.

McKim Gaskets and a full line of Mechanical Force Feed Lubricators were displayed at the booth of the McCord Mfg. Co. of Detroit. A. C. Pickard explained the construction and working features of the exhibit.

There's No If about the Automatic Engine Stop and Speed Limit System built by the Metallic Packing & Mfg. Co. of Elyria, O., said F. S. Palmer, the company's manager. Their line of metallic packing was also shown and the booth proved a head liner for drawing attention.

The Keystone Lubricating Co. of Philadelphia had 5 men at the convention and they were always busy. Keystone Grease Cups and Keystone Grease for all lubricating purposes was all they could find time to talk about. C. A. Hopper, T. W. Armstrong, F. Gentry, M. B. Urquhart and F. A. Morris were the representatives.

The Mayer Coal Co. of Kansas City displayed coal of the Semi-Anthracite variety, which is sold under the trade name of "Cherokee" steam coal. W. I. Crane was the man in charge.

Packing for every purpose for which packing is used was displayed by A. W. Chesterton Co. of Boston, whose booth was in charge of H. D. Raymond. The line included Vaporite and Combination sheet packings, Metalbestos and Rubberbestos spiral. Sonderglas gage glasses and a Chesterton Combination scraper and flue brush were also shown.

An eight inch electrically operated gate valve with drum control and flash light indicators, showing the position of plug during operation was one of the interesting features displayed by The Chapman Valve Mfg. Co. of Indian Orchard, Mass. Bronze swing check valves, Star Spindle valves and a line of extra heavy valves in bronze were also shown. One 4-in. parallel seat valve and a 6-in. steel valve completed the exhibit. J. C. Eardley, J. McC. Moffett and W. J. Neville did the honors.

Skookum diagonal piston packing was on display at the booth of the Bowers Rubber Works of San Francisco, Cal., and Dick Fleming was official demonstrator. Dick carefully explained why Skookum packing would expand 100 per cent in either direction under pressure and then clinched his argument by making a practical test that left no room for doubt.

Semi anthracite coal from Missouri, Arkansas and Wyoming does not look much different from the variety mined in other sections of the country, but G. F. Williams of the Central Coal Co., of Kansas City, convinced a good many people that it gives far better steam results than any other kind.

Dart unions, Fairbanks valves and Fairbanks pipe wrenches were shown in the booth of the Fairbanks Co. of New York, which was in charge of L. B. Mann and H. T. Seymour.

The exhibit of the Homestead Valve Mfg. Co., of Pittsburgh, was well arranged and the display interested everyone mechanically inclined. The line consisted of Homestead blowoff valves, straight way, 3-way and 4-way valves in various sizes and for all purposes. C. B. Ault presided.

The Kansas City Rubber & Belt Co., of Kansas City, showed a general line of rubber and fibrous packings, including N. B. O. and Vanda products. J. Backus was the representative.

Uehling Recording Instruments were shown in the booth of the Kansas City Engineering Co., of Kansas City, who also distributed literature of A. L. Ide & Son, of Springfield, Ill., for whom they are local agents.

The booth of Adam Cook's Sons of New York, was in charge of W. D. Naughton, who had everybody sliding his way to inspect the latest thing in the lubricant line. Albany Grease for cups and Cook's Lubricant for automobile gears were the new attractions—while Albany Grease in its various forms for all lubricating purposes formed the main display.

The Diamond Power Specialty Co. of Detroit, displayed a line of Diamond Soot Blowers. C. A. Burton was in charge and the exhibit attracted many visitors to see how the blowers "clean every tube."

Hoisted right if it is done by a Yale and Towne block such as were exhibited by D. A. Wright for the Yale and Towne Mfg. Co. of New York. The exhibit was complete of chain hoists and trolley hoists working on jib cranes. Security and the Yale padlocks shown by J. W. Barthell for the same company are synonymous in the minds of all good Americans. The 100 page catalog told the whole story and can be had by mail on request.

That feed-water level need never worry if it is watched by a Williams safety feed-water regulator, and the high and low water alarm gives due warning of any pump irregularity. Pump governors, water gages, B. T. self-grinding and quick closing gage cocks, and Williams steam operated traps completed the exhibit of the Williams Gauge Co. of Pittsburgh, Pa., in charge of J. W. Shea and C. E. Wolff, Jr.

How's your speed? If it is varying the fluctuation recorder shown by Schaeffer & Budenberg Mfg. Co. of New York, will tell you how and how much. W. H. Shenton, western manager, explained the method also showed the Durax high-pressure gage glasses, temperature recorders, pressure recorders, combined barometer and vacuum gage and a full line of hand and stationary Columbia tachometers.

Efficiency and economy in power plants are aided by clean boiler tubes and the Holt boiler tube cleaners help. They were in the exhibit

of the Rosedale Foundry & Machine Co. of Pittsburgh, Pa., represented by J. N. Oswald, who also had pamphlets explaining the Holt automatic strainer, the Playford chain grate stoker and the Pittsburgh shaking and dumping grate.

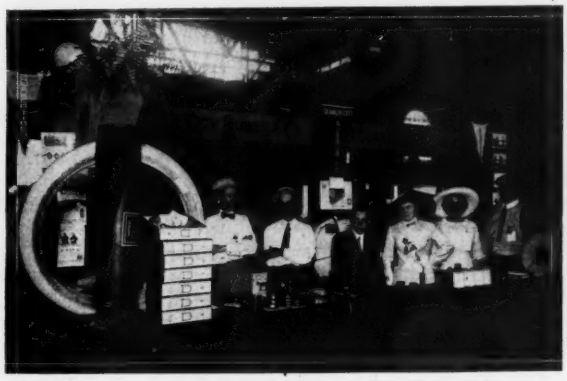
Individual oiling systems of Richardson and Phenix types were the main feature of the booths of The Richardson-Phenix Co., and the Peterson Engineering Co. of New York. Mechanical force feed lubricators, Union Cinch fittings, sight feed, etc., were explained in the literature on Scientific Lubrication of Machinery distributed by G. E. Peterson for the company.

To soften boiler waters, boiler compound; for hydraulic elevators, elevator compound; for all elevators, elevator lubricant, were the aids shown by W. B. McVicker Co., represented by John McDonald. Cleansing, disinfecting and soap powders were also of interest.

Burning slack with a forced draft was the system demonstrated by the Palmer Forced Draft Slack Burner Co. of Ft. Scott, Kansas. H. V. Rice, the representative, explained how to burn a less amount of low grade coal with better results.

The Story of Some Friction Tests and Hobson's Steam Engineers Blue Book were the literature of the Quaker City Rubber Co. of Philadelphia, which showed the advantages of Daniel's P. P. P. regular, special, marine and rod packings and the Ebonite sheet as well as a full line of other rubber goods including the "Miles Cheaper" tires, Ironsides rubber belt and Q. C. R. Co. pump valves. H. Rittenhouse and J. S. Young were the hosts.

Marco the trademark of the Mechanical Rubber Co. of Cleveland, Ohio, was found on the exhibit of hydraulic, diagonal red, Jupiter and



metallic packings in its exhibit which was superintended by A. C. Conway and C. H. Boyer.

Sections of injectors, of automatic and positive types, grease and oil cups, gas engine oilers, dust proof and ratchet cups for autos, the automatic safeguard water gage and the new Penberthy valves made up the display of the Penberthy Injector Co. of Detroit, Mich., which was in charge of R. J. Parvin, Jr.

Removable seats and discs specially designed to protect the seat were the features of the Osborne valves shown by the Osborne Valve & Joint Co. of Chicago. Regrinding relief valves, quick opening lock valves, expansion valves and special fittings, completed the exhibit in charge of W. L. Osborne.

Grease for cylinder lubrication by means of the Ohio lubricator, and grease for journal lubrication were explained and advocated by G. A. Null, J. C. Ross and R. E. Schoonover for the Ohio Grease Lubricant Co. of Loudonville, O.

Regrinding valves and discs of the regrinding and regular types, besides a full line of oiling devices, were seen in booth 181 occupied by the Ohio Injector Co. of Wadsworth, O., with C. L. Wait in charge.

When the pipe cracks, the Emergency pipe clamp comes to the rescue; and the Climax steam joint clamp does the same for the leaky joint. If it's in the flange, the Model flange clamp applies; when the valve leaks the Skinner valve reseating tool is needed and for the dripping bibb cock, the Skinner bibb reseater is the remedy. All these were shown by M. B. Skinner and K. G. Merrill acting for James McCrea & Co., "leak doctors."

"Look pleasant please," or if you prefer look natural, were the instructions at the booth of The Lunkenheimer Co. of Cincinnati. Why? Because you were having your "picture took" for identification purposes, to be placed in the card case with which you were presented when the operation was over and you had examined the attractive exhibit of Renewo and Ferrenewo valves, non-return boiler stop valves, cast-steel valves and the general line of steam appliances. To execute the photographs and explain the specialties there were present Lane Thomson, J. H. Hewetson, R. E. Poole and H. R. Allonier.

"Clean 'em up when they're scaly and then keep 'em clean." That's the purpose of the Weinland tube cleaners with motor for driving power, air, water or steam as you choose. For Stirling boilers there was a new feeding in device, for condensers a special small head cleaner, and for return tubular boilers a new air or steam driven cleaner. Then to insure clean feed water, the Lagonda Enterprise multiple water strainers and for safety and general convenience the Lagonda automatic cutoff valves, tube cutters and reseating machines. All were arranged convenient for examination in the large space of the Lagonda Mfg. Co. of Springfield, Ohio, and were demonstrated by M. M. Sellers, J. H. Johnston and J. P. Maloy.

"Effective, simple, positive" was the statement of the Imperial Brass Mfg. Co. of Chicago, Ill., regarding its Imperial Model A. mechanical

lubricator which was shown in section, in detail and in all sizes, and carefully explained by the designer and inventor, J. F. McCanna. The catalog 37 explaining the Imperial was striking as to the cover design and the attractiveness of cuts and information in the reading matter.

Durabla products implies that they are durable and Jack Carson, for the Durabla Mfg. Co. of New York, assured visitors that it was so. The exhibit included the German gage glass, the valve discs newly introduced in this country though long used in Germany, sheet packing and gaskets. All "Durabla," i.e. durable.

For high or low pressure, on rods the Vanda fiber piston and valve stem, for joints the Vanda tubular gasket, for sheet packing the Vanda black sheet. This was the advice at the booth of the Vanda Co. of New York, where all kinds were on display in charge of P. Hassenclever.

Bubbling with refreshment for the hot days was the Ashton sanitary bubbling drinking fountain exhibited by the Ashton Valve Co. of Boston; it is unique in that no change of faucet or bowl is necessary, and the convex top type is non-squirting. Other products more specially related to power plants were Ashton Special Valves, including the pop

safety, with locked adjustment, an Adjustable Pop Cylinder Relief, Water Relief, Hydraulic and Blowoff Valves, and Ashton Gages including pressure and vacuum, indicating and recording gages, compound gages, gages for altitude and for testing, whistles and the Ashton Inspectors' and Dead Weight Gage Testers. Harry Ashton, President of the N. E. A., and Columbus Dill were on hand for the company.

THE OPERATING ENGINEERS

Second Annual Convention of the Institute in New York, Sept. 6 and 7

THE Second Annual Convention of The Institute of Operating Engineers was called to order Friday morning by President J. C. Jurgensen, and was addressed by C. A. Prosser, secretary of the National Society for the Promotion of Industrial Education. Mr. Prosser's address was listened to with deep interest by the assembled delegates who called attention to the fact that The Institute of Operating Engineers was a member of his society, and that the work of the Institute was along the very lines that interested those who sought to promote industrial education.

Responding to Mr. Prosser's address, President Jurgensen called attention to the need of determining the facts in regard to the vocation of steam engineering before starting on any system for improvement. He spoke of the work of the Department of Vocational Statistics of the Institute and the lack of definite workable means for training efficient workmen in the essentials of economic plant management to fill the growing demand for highly skilled engineers.

He referred to the need for cooperation between engineers, employers and apprentices and to the educational principles and ideals of the Institute which have been tried out successfully in actual work for 10 yr., and of the effort to select and register suitable young men as apprentices, to secure cooperation of boards of education and educational institutions in offering vocational courses for evening and home instruction, and the plan for recognizing progress as it is made.

"The training offered must include moral and intellectual as well as vocational training, for the foundation of character and equipment for useful life work.

"The Institute is a broad gage, organized effort by men who believe in self help and realize the need of education for plant workers. We depend for success on the modest dues asked for and on the determination and pride of our farsighted members to make their vocation what it ought to be.

"I am glad to testify that the spirit and principles of the Institute have been instrumental in causing operating engineers generally to show more progress and diligence along educational lines than ever before. Engineers are beginning to see that it is not all of operating engineering to know how to do the work of the engine room, but that a vast deal of knowledge and judgment must come into play as to the fundamental principles of engineering and the science of power plant management. The engineer must study the how and the why or he is no operating engineer.

"The Institute is a school for plant workers, which is to become an exchange for experiences, facts and ideas. It is an association of workingmen where all are admitted and meet on a common level, each to learn of the others, and the more experienced to act as instructors to those seeking knowledge.

"The originators of the Institute after years of deliberation have produced a course and a plan which is now offered by several prominent schools and colleges, and a large number of our members are following the Institute Home Study Course and its special course given by the American School of Correspondence.

"The Institute will in time accomplish all its objects and become of immense value to every plant worker. To follow its lead makes for clearer thinking, more practical training and better power plant management, all of which will mean the moral and material advance of operating engineering."

The Secretary's report followed next. This report showed that there was an average attendance of 52 at the monthly meetings in New York, and that the work of the various departments had progressed as well as could be expected. The lecture courses given during last winter's sessions, were well received and well attended, as above noted. The enrolled membership to date is 391. Of these, the Institute lost through death, 6, as follows: Niles Poulsen, F. B. Kruckman, Wm. Sager, J. G. Ould, G. F. Stillman, all of Brooklyn, and L. B. Smith of Georgia.

Twenty members have resigned upon entrance into another field of work or on account of finances, leaving the present membership 366.

The Treasurer's report was next read, showing total receipts for the fiscal year, $2289.07; disbursements, $2204.01, leaving a balance on hand Sept. 1, 1912, of $85.06. After the reading of the above reports, auditing and nominating committees were appointed by the chair.

At the afternoon session, Secretary H. E. Collins occupied the chair, and the time was occupied in the reading and discussion of papers. The first presented was by A. Gordon, chief engineer of the Boston Store, Providence, R. I., on

The Tungsten Lamp and the Overloaded Plant

IT was read by V. L. Rupp, and after referring to early lighting and the greatest improvement of tungstens, it gave figures to show how the tungsten or Mazda may come to the rescue when more light is needed or lines are overloaded.

The 25 watt tungsten gives about 19.1 candlepower or 20 per cent more light than a 16-candlepower carbon lamp for half the current, and a 400 watt tungsten can replace a 5-ampere arc which takes 550 watts. Thus in a plant carrying 2000 16-cp. 50 watt. lamps and 200 5-amp. arcs, and requiring 210 kw., the same light can be had from Mazda lamps with a saving of 80 kw., which will be available for additional lighting. For the 400-watt lamps, the bowl frosted with open prismatic reflectors are recommended, or, if the ceiling height is not over 14 ft., the 300-watt Mazda will give about as good light as a 5-amp. arc, and for 12-ft. ceilings, with goods not too dark in color, a 250-watt Mazda is satisfactory, effecting a further saving in power.

In Mr. Gordon's plant he has added by replacing old style lamps with tungstens, over 26,000 ft. of floor space, 22 kw. of refrigerating power and extra lighting to a previously overloaded plant, and now has 27.5 kw. available for further extension.

Trimming and repair of arc lamps is also done away with, a considerable advantage in a crowded store, and the overloading of lines with consequent increased drop of voltage is done away with.

Cost of renewals is almost met by the saving in glassware on the arcs, and the life of the Mazda, which is guaranteed at 1000 hr. by the makers, has been found to be at least 2000 hr.

For a new installation, the reduction in generator capacity needed will cut the cost of the plant down

to 60 per cent of that where carbon lamps are to be used, so that a duplicate generating plant with ample boiler capacity can be installed for less than could a single plant a few years ago. Boilers can be installed of less horsepower, or, if liberal power is allowed, a cheaper grade of fuel, screenings or buckwheat, mixed with bituminous coal can be used without violating the most stringent smoke laws.

As to matching colors, Mr. Gordon classes this as largely a fad, and thinks that it can be done as well under Mazdas as under most arcs or even under daylight which is reflected from colored walls.

Electric vs. Steam Drive

IN the second paper, Joseph F. Carman, chief engineer of Abraham & Straus of Brooklyn, compared steam and electric drive for pump, fans, etc. In the steam pump, the coal consumption will run to 12 lb. of coal per horsepower-hour while the electric, triplex double acting driven from the prime mover will require only 4 lb. First cost of the electric pump is high, but is soon repaid by low cost of operation.

Although in less amount, like disparity is found between steam driven and motor driven fans, ash conveyers, etc. Also, there is the extra care of the steam engines, danger of freezing of cylinders, which are often in exposed places, if the drips are left closed, bearings and valves to keep in order and oilers to be matched all of which effort may be used to better advantage in other directions.

The third paper by P. Lundeley of Monterey, Mexico, on Keeping Tab in Industrial Plants was a summary of what records are desirable and will appear at length in a later issue.

Graduation

IN the evening the comencement exercises were held and diplomas awarded to a class of 7 who had taken the course as outlined by the Institute and taught in Columbia University. The graduates were, Michael Furlong, John F. McDonough, John J. McGinley, James Fagan, Alonzo McLaughlin, George Pattberg and Harry W. Wright.

Prof. Maxwell of Pratt Institute gave the address, emphasizing the need of the student making sure of his fitness for engineering before going too far, and advocating practical work before a college course or early in it to determine the student's qualifications as an engineer. Michael Furlong gave the valedictory and the diplomas were presented by President Jurgensen who congratulated the graduates on their work, and called upon them to guard their reputation both personal and professional as a duty to the Institute and the calling.

Following a recess, a paper by Robert H. Karl of St. Louis, was read by F. L. Johnson on the Influence of Suction Pressure in Ammonia Compressors, and discussed by H. W. Geare of New York, both of which will appear later.

Constitution Changes

ON Saturday morning the reports of committees were heard and changes adopted in the constitution, the chief one being the introduction of a grade of Junior Engineer between Apprentices and Journeymen Engineer the requirement being 21 yr. of age and 5 yr. experience, the initiation fee to be $5 and yearly dues $5. Also, the Institute Council is changed to consist of the president, treasurer, 3 vice-presidents, who are in charge of the 3 departments of Institute work, and 12 commissioners, one from each district and 3 at large; also the 2 latest past presidents. President and treasurer hold office for 1 yr., and vice-presidents and commissioners for 3 yr., one vice-president, 3 district commissioners and one commissioner at large being elected each year. The Secretary is appointed yearly by the Council.

Papers followed by W. Senge on Extra Exhaust Valves in a Watertown Engine, and by W. A. T. Willink on Steam in a Sugar Cane Factory.

Election

IN the afternoon report of the nominating committee was received and the officers elected were:

President, F. L. Johnson, Chief of Construction Department, Edison Electric Illuminating Co., Brooklyn; Vice-president and Director Department Branches and Meetings (1 year), W. J. Fair, Chief Engineer Murray Hill Hotel, N. Y.; Vice-president and Director Industrial Education and Training (2 years), W. G. Freer, Chief Engineer Citizens Central Bank Bldg.; Vice-president and Director Vocational Statistics and Employment (3 years), V. L. Rupp, Chief Engineer Williamson Trade School, Williamson School, Pa.; Treasurer, W. P. F. Hill (re-elected), Chief Engineer Woman's Hospital, N. Y.; Commissioners at Large, L. Houmiller (1 year), Darrow Sage (2 years), Robert Langlotz (3 years); Commissioners District No. 1, J. L. MacVicar, Chief Engineer Boston City Hospital; No. 2, W. A. T. Willink, Erecting & Designing Eng., Arbuckle Bros, N. Y.; No. 3, D. B. Heilmann, Inpector Philadelphia & Reading Ry. Co., Reading, Pa.

ROUGH TURBINE BLADES DECREASE CAPACITY

WHERE I am employed we have a 500-kw. Curtis turbine. When this machine was installed it would carry 750-kw. with 160 lb. steam pressure and 28 in. of vacuum when all valves were open.

After about 2 yr. service we noticed that this machine was gradually losing power until it got so that but 500-kw. could be carried with the same steam pressure and vacuum. At this time the Allis Chalmers Co. was installing one of their turbines here.

One evening I was talking to one of their men. He told me that he formerly worked for the General Electric Co., on their turbines. He told me a great deal about turbines, but never mentioned anything about their losing power. I spoke to him about our Curtis lying down, He asked me if I was sure that there was 160 lb. of steam pressure in the steam chest, as he had seen cases where the strainer in the steam pipe had become partly obstructed with scale from the boilers.

I connected a gage to the steam chest that night and found that the pressure was up to standard. I told him what I had done and what I found the next evening.

"Well" he said; "it must be caused by the edges of the blades being worn blunt or cut and pitted and I should take out the first stage intermediate and examine the blades, if the edges are not sharp I should sharpen them up with a file." When I took out the intermediates that night I was surely surprised, the edges were all pitted and ragged; I sharpened them up the best I could and put them back in place. When we put the load on, this machine carried 625 kw. We ordered a new intermediate from the General Electric Co., and when we put this in place the machine carried her 750 kw. as well as ever. I since found out that the cutting and pitting of the blades is due to wet steam. H. W. H.

PRACTICAL ENGINEER

Trade-mark reg. U. S. Pat. Office.

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH
At 537 So. Dearborn Street, Chicago, Ill., by the
TECHNICAL PUBLISHING CO.

New York, 150 Nassau St. Cleveland, Am. Trust Bldg.

Subscription Price One Dollar a year in advance to any Post Office in the United States or Mexico or United States possessions.

To Canada One Dollar and Seventy-five Cents; to Other Countries Two Dollars and Fifty Cents a year. Single copies 10 cents.

Address all letters and make all checks and money orders payable to Technical Publishing Co., 537 S. Dearborn St., Chicago, Ill. Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

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Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

Circulation of this issue, 22,500

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EDUCATION AND PROGRESS OF THE N.A.S.E.

The convention at Kansas City may well be pronounced epoch-making in the history of the Association, although the work which has made it such has been carried on throughout the past year. The Association, which has at all times done good work, but has perhaps not always taken advantage of all its opportunities, is thoroughly aroused and the membership and officers appreciate the wise advice and plans which have been furnished by the experienced educators who have acted on the Advisory Board. A keen-thinking and far-sighted President, with a great vision of the possibilities of the Association, with energy to start that vision towards realization, and executive ability to accomplish what he desired, has worked wonders in a single year, and a wise choice of officers for the coming year has insured the continuation of this success.

The forward steps, which are given in detail in the report of the convention, include the establishment of a lecture bureau, the furnishing of slides for the use of local associations, a series of instruction papers with questions, the suggestion of study topics, the encouragement and assistance of state and district associations to carry out real educational programs, the assistance of local associations in laying out programs and courses, and the awarding of prizes to stimulate interest and keep up activity. The outlook is certainly a bright one, and the Association can hardly fail in making great progress.

On one point only might a suggestion be made for possible improvement. Year after year at the National Conventions there are to be seen a large proportion of the same faces. While there is some advantage in the smooth working of the organization in having a percentage of experienced delegates on the ground, there is certainly much of value to local associations, to the members themselves and to the exhibitors, who spend time and money to put their apparatus before the delegates, in having new visitors and delegates at the convention. While there is always a difference in conventions, yet the general atmosphere from year to year is the same, and the good which an engineer who has never attended such a convention can get from meeting other engineers from all over the country, and the novelty of his experience is sure to give a fresh point of view in his report to the association at home after he returns. The fact that attendance at the convention is passed around among members, is also likely to arouse enthusiasm and interest of the members in their association and in the meetings; and the exhibitors will certainly gain by having each year new delegates, to whom they may explain their products and who will carry home different ideas and impressions to report to their fellow members.

We offer it as a suggestion worth careful consideration, that associations make it an unwritten law that delegates be not sent to conventions two years in succession, but that the honor and pleasure accompanying such a trip be passed along year after year, either as a recognition of interest and good work in the association, or of special fitness to represent the association at the convention, and that, if necessary, assistance be given members in securing engineers to fill their places while they are attending the convention.

ECONOMY IN SUPERHEATING

Possible Saving in Steam and Coal by the Use of Superheat and Design of Superheaters to Give Control of Steam Temperature

IN an article by E. D. Dreyfus in the April, 1912, Electric Journal, the per cent decrease in the turbine water rate due to the use of superheated steam is given as follows: 50 deg. superheat, 5 per cent, 100 deg. superheat, 10 per cent; 150 deg. superheat, 14 per cent. A paper entitled Recent Developments in Steam Turbine Practice by K. Baumann, read before the Manchester section of the Institution of Electrical Engineers, January 16, 1912, gives the following figures: 0 to 100 deg. F. 1 per cent improvement in the steam consumption for every 10 deg. F.; 100 to 200 deg. superheat 1 per cent improvement of steam consumption for every 12 deg. F.

This paper also brings out another important point, viz.: that the efficiency referred to the Rankine cycle increases considerably with increase in superheat, the following figures being given: For 100 deg. superheat 2.5 per cent better efficiency and 6.75 per cent better efficiency for 200 deg. superheat.

The improvement in steam consumption and turbine efficiency given above due to the use of superheat, are compared to the efficiency and steam consumption with dry saturated steam. Ordinarily, however, steam supposedly dry, will contain a small amount of moisture which causes a reduction in efficiency. According to the paper referred to above, the efficiency will change 1 per cent for each 1 per cent variation in wetness, and therefore steam consumption measured as condenser water per horsepower hour will be 2 per cent higher for each 1 per cent increase in moisture.

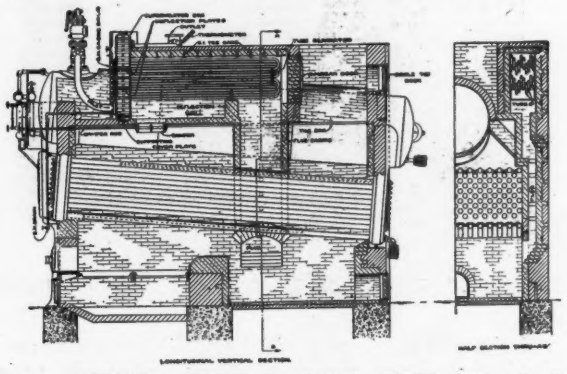


FIG. 1. SECTIONAL VIEWS OF HEINE BOILER AND SUPERHEATER SHOWING DAMPER WHICH CONTROLS GASES SENT THROUGH SUPERHEATER

With reciprocating engines, the presence of moisture in the steam has a still greater detriment effect as it greatly augments cylinder condensation. For this reason increase in economy of 12 to 20 per cent is not uncommon with superheating only about 40-100 deg. F.

Fuel Economy

SAVING in coal consumption, due to the use of superheated steam is not as large as the percentage saving in steam consumption. 100 deg. superheat will reduce the steam consumption of a turbine, say, 10 per cent. This means that instead of 1 lb. of water evaporated under dry and saturated conditions, only 0.9 lb. of water need be required if the steam be superheated 100 deg. Assuming the feed temperature as 200 deg., the heat absorbed in the boiler for 1 lb. of steam at 150 lb. gage, without superheat is 1027 B.t.u. The heat in 0.9 lb. of steam under the same conditions, is 924.3 B.t.u., the difference, 102.7 B.t.u. being saved.

To secure this saving in the amount of water evaporated, 100 deg. superheat must be applied to each pound of steam. According to the latest steam tables, this requires 57 B.t.u. per pound or 51.3 B.t.u. for 0.9 lb. This amount of heat, added as superheat, saves twice as much heat, 102.7 B.t.u. in the boiler.

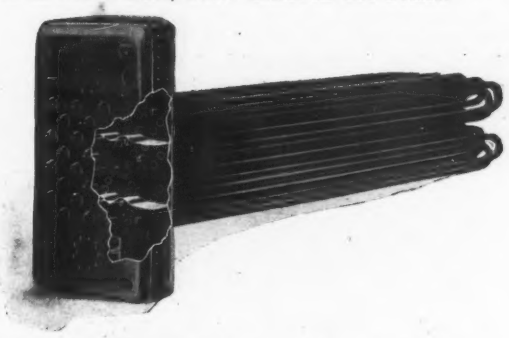


FIG. 2. HEINE SUPERHEATER SHOWING HEADER CONSTRUCTION AND DEFLECTING DIAPHRAGMS

It may therefore be said that by using superheated steam there is obtained a fuel economy equal to half the steam saving. This means that heat imparted to a superheater is just twice as valuable and generates just twice as much power as heat imparted to a boiler.

If by using superheated steam, 10 or 15 per cent of the output of a plant may be generated for just half the cost of the remainder of the output, it is of great importance that the superheat for which the turbine or engines are best adapted be determined by trials and then maintained continuously. The temperature of the steam should not be allowed to fall below that value, since economy is sacrificed, and on the other hand the temperature should not be allowed to exceed the predetermined value, as troubles with valves, fittings and cast parts are liable to arise.

How Much Superheat?

WHEN the economy of superheating was first realized, superheats as high as 300 deg. were sometimes specified, and superheaters with a good many square feet of surface installed. It was found, however, that steam at these very high temperatures gave a great deal of trouble and caused rupture of cast-iron valves and fittings. By substituting high grade cast-steel, high superheaters could be carried, but the added cost for these improved fittings tended to counterbalance the added returns from the use of higher steam temperatures.

As a result, it has been found that the highest commercial efficiency, everything considered, is secured by the use of moderate superheat, and it has now become quite general practice to run at 125 to 150 deg. F. in turbine plants, and the same or somewhat lower superheat in reciprocating engine plants, where a low superheat eliminates losses from moisture and reduces cylinder condensation without causing lubricating troubles.

The temperature to which steam will be superheated depends first upon the amount of steam flowing through the superheater tubes and its temperature, and second upon the amount of gas flowing over the tubes and its temperature. As the quantity of steam is controlled by the boiler load, the temperature of steam will be determined by the amount and temperature of the hot gases, which will in turn depend on the design and arrangement of boiler and superheater.

It has been found therefore, that in order to secure constant superheat, it is necessary to control the volume of gases which pass over the superheater surface.

Regulating the Temperature

ONE method of installing a superheater is illustrated by Fig. 1 which shows the Heine superheater. The superheater itself, is shown in Fig. 2 and consists of a header box into one side of which are inserted U tubes made of 1½-in. seamless drawn mild steel tubing, expanded into holes provided for them. Hollow staybolts are used in the header and provide means for

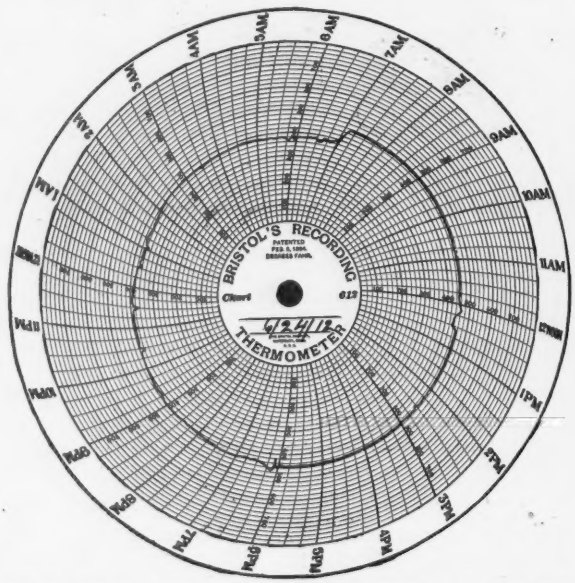


FIG. 3. RECORD FROM A HEINE SUPERHEATER. CLOSE REGULATION DURING WORKING HOURS, 7 TO 12 A. M. AND 12:30 TO 6 P. M., AND REDUCTION OF SUPERHEAT AT NIGHT BY CLOSING THE DAMPER

introducing a soot blower in order to keep the exterior surfaces of the superheater tubes free from soot. The header box is divided into 3 compartments, so that the steam makes 4 passes through the tubes.

The superheater is located at the side of the shell towards the front of the boiler and a small flue built in the side walls of the setting (see Fig. 1 Section on AB) carries hot gas from the furnace into the superheater chamber. The gases passing up this flue come in contact with only a small part of the boiler surface and then enter the superheater chamber, making 2 passes over the superheater surface.

According to a number of experiments, including tests at the new Grand Central Heating Plant in New York City, containing 6000 hp. of Heine boilers and superheaters, the temperature of the gases entering the superheater is about 1500 deg. The average gas temperature is thus about 1000 deg. F. and with an average steam temperature of 425 deg. the difference in temperature is 575 deg. With this arrangement high superheats may therefore be obtained and each square foot of superheater surface has a great capacity.

By installing the superheater as shown in Fig. 1, the advantages of the independently fired superheater are obtained without the disadvantages. A damper in the outlet of the superheater setting controls the volume of hot gases used; and can shut off the flow of combustion gases entirely, when no superheat is desired or when the load goes off.

This arrangement makes it unnessary to flood the superheater and avoids accumulation of mud and scale in the tubes. By setting the damper at different positions up to the full opening any desired degree of superheat may be obtained. The damper may be regulated by hand from the front of the boiler, or by a simple automatic damper control installed in conjunction with the superheater. With this equipment, the temperature of the superheat is controlled to within 5 deg. of any desired figure, as shown, for instance, by the chart Fig. 3 obtained in an installation of this type.

This superheater is in service from 7 a. m. to 12 noon and from 12:30 to 6 p. m. While the load is on, the superheat is automatically controlled with the close regulation indicated by the chart. From 12 to 12:30 when there is no demand for steam, as well as during the night, the damper is closed; flooding is unnecessary

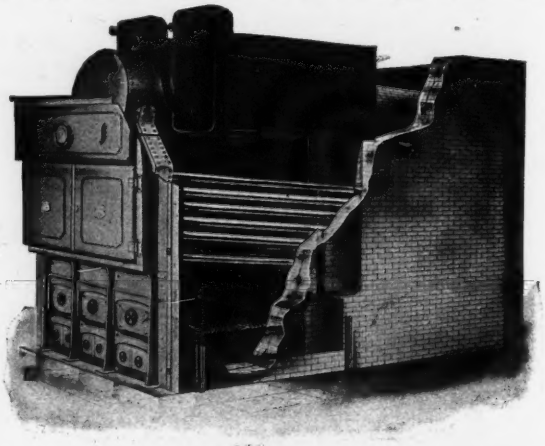


FIG. 4. ARRANGEMENT OF HEINE BOILER AND SUPERHEATER. NOTE FLUE AND CONTROL DAMPER

and there is no danger of overheating. No steam is flowing through the superheater, which is acting simply as additional steam storage space. The steam is stored at a temperature but little higher than boiler temperature; in fact, its temperature decreases slowly, indicating that the supply of heat from hot combustion gases is entirely cut off by the closing of the damper.

WHILE THE OLD and best deposits of coal are being depleted, new fields are being mapped by the U. S. Geological survey as a resource for the future. Two have recently been defined in Utah, one in Uinta Co. of 25 sq. miles area which will yield some 35,000,000 tons of low grade bituminous, but is too far from the railroad for present development. The other is in Wasatch Co., about 25 miles from the railroad over a fair wagon road. The coal is a rather low grade bituminous with probable yield of 1,860,000,000 tons, but a plentiful supply of wood in that region has so far prevented development of any mines.

REPAIRING LEAKY WROUGHT IRON PIPE

36-in. Pipe Repaired in Place at Low Cost and Without Interrupting Its Usefulness

By Frederick La Townrette

MANY times what seems a difficult problem can be solved in a surprisingly simple manner, as in the following case. This problem was the repair under difficult conditions of a 36-in. riveted pipe, of ⅜-in. wrought iron, which had been in service for 35 yr., under the floor of a bridge. Originally the pipe had been under the plank floor of a truss highway bridge, and had become deeply pitted by street droppings from overheard. When the bridge was replaced by a reinforced-concrete arch of 60-ft. span, a part of the pipe was built in, the rest being exposed for a distance of about 50 ft. near the top of the arch. As a result of the pitting on the outside and the scour within, the pipe recently began to leak badly, and some means of repairing it cheaply and quickly became imperative.

Above this point the pipe is on a considerable grade, so that it often runs full and occasionally under some pressure. The pitting extended around the entire circumference, and leaks developed along the whole length of the bottom and for about ⅓ the distance up the sides. As the pipe was suspended over a street, and the flow could not be diverted to another pipe, the situation called for prompt attention.

Plans were considered for making repairs by leaving the old pipe in place and building another of 4 in. larger diameter around it, filling the 2-in. space between with Portland cement grout. This method would have necessitated cutting away the arch ring around the pipe, inserting the covering pipe in semicylindrical sections, and replacing the arch ring with new concrete when the new pipe was in place. Only one bid was received for undertaking the work under this plan, and that bid (about $3,600) was out of all proportion to the necessary cost of the repairs.

It was then that we hit upon the idea of using a patented iron cement known as "Smooth-On" iron cement, which is made by the Smooth-On Mfg. Co., of Jersey City, and had been previously used in some minor cases with complete success. The chief problem now was that this cement would not hold unless applied to a perfectly dry surface. Some way had to be devised for stopping the innumerable leaks.

This was accomplished by first removing all loose rust and scale. The leaks were then stopped by inserting dry wooden plugs, carefully whittled to fit the pits, some of which were nearly as large as the palm of the hand. With the patient application of many plugs and a liberal use of red lead and shellac most of the leaks were overcome. One particularly bad place was fixed by covering it with a piece of burlap which had been previously prepared with coatings of shellac and red lead. This was smoothed over the leaky area and held until the lead had set. All leaks were finally closed and a dry surface obtained. The entire surface of the pipe was then painted with a solution of "Smooth-On" cement No. 2, applied with a heavy paint brush. When this coat was dry a heavier covering of the same material was troweled on.

The concrete arch was cut away from the lower half of the pipe, so as to allow the semicylindrical

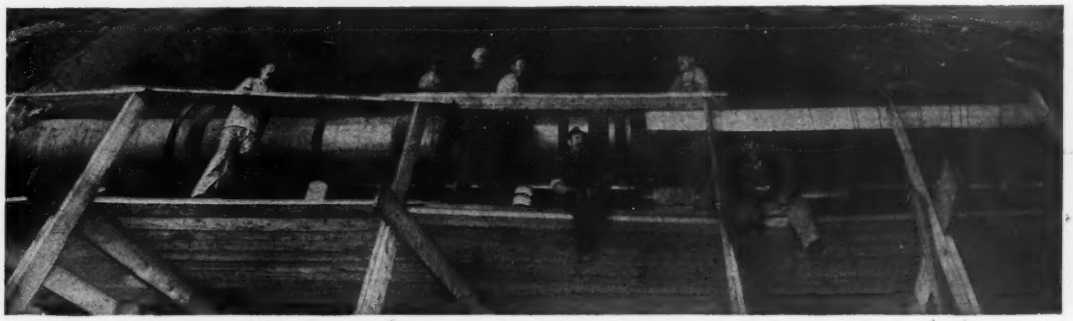


FIG. 1. MAKING REPAIR ON 36-IN. PIPE

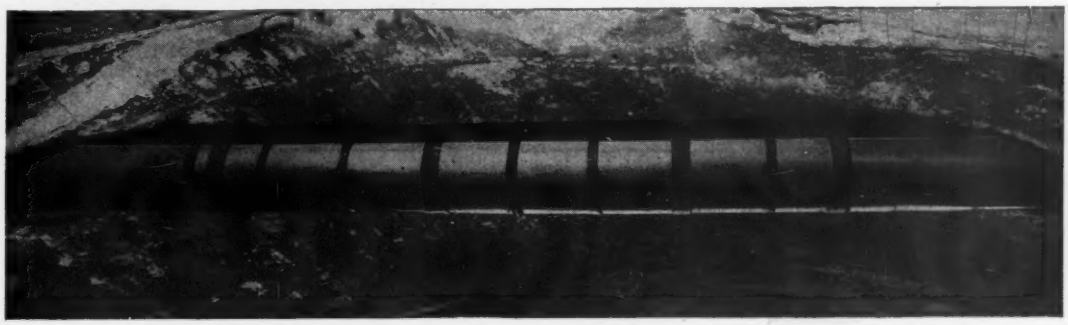


FIG. 2. APPEARANCE OF COMPLETED REPAIR ON PIPE

plates which were used to cover the lower half of the pipe to enter 12 in. into the soffit. These plates were 3/16-in. thick and about 10 ft. long, curved to a radius about 1 in. greater than the greatest outside radius of the pipe. The joints between the plates were made by butting the ends together and covering them with a 3/16 by 8-in. iron band which passed entirely around the pipe. Between the joints were 2 3/16 by 4-in. bands which also bound the semicylindrical outside shell to the old pipe. The inner surfaces of the bands were carefully coated with soft cement before the bands were put in place.

The space between the shell and the pipe was then poured full of a mixture composed as follows:

Smooth-On concrete iron cement No. 7..... ..... 1 part by volume
Sharp sand .....1 part by volume
Dykerhoff Portland cement.....1 part by volume

This space varied from 7/16 in. over the outside plates of the pipe to 7/8 in. over the inside plates. The top of the pipe was then plastered over with a coating of the same mixture applied with a trowel. When completed the pipe was as good as new at a cost of about $1000. The accompanying illustrations show the work in progress and the completed job.

NEW AIR METER

METERING of compressed and free air and of the fixed gases has become a necessity in our industrial progress. Estimating half the quantity and multiplying it by the cube root of 8 would not be satisfactory now to the commercial superintendent or engineer because there are better methods of getting the facts. Fairly accurate results are obtained

TITOT METER FOR MEASURING AIR OR GAS

of the volume or weight of air or gas flowing through a pipe by multiplying the cross section by the average velocity obtained by the formula.

$$V = \sqrt{2gh}$$

It is essential to get this head, h, very accurately to insure correct results.

On account of the meniscus of a liquid in a glass tube changing its condition the ordinary head cannot be read much closer than 0.1 in. in a vertical tube. In order to get closer readings and consequently more accurate determination, the Pitot Meter for measuring air or gas shown in the illustration was brought out.

It can be attached to any pipe from ½ in. up and on account of its light weight can be used for a portable as well as a permanent meter.

The meter consists of a brass tube or well, around the circumference of which is spun a semicircular groove in which is wound a transparent celluloid tube the lower end of which connects to the well and the upper end to a passage through the yoke and cock to the tube in pipe whose opening is perpendicular to the flow of gas or air.

The well is connected by a similar opening through the yoke and cock to the Pitot tube having one or more openings facing the flow of the air or gas.

Water or oil is put into the well through an opening made for the purpose until it reaches a zero mark on the helix. When the cock handle is vertical the space above the fluid in the well and above the fluid in the helix are both open to the atmosphere, and if the fluid stands at zero; under these conditions, accurate results will be obtained.

By turning the cock handle 90 deg., as shown in cut, the well is connected with the air or gas pipe through the Pitot tube and the space in the helix is connected to the same pipe through the straight tube. If there is no velocity to the air or gas in the pipe, the liquid in the helix will still remain at zero irrespective of the pressure. In other words, the static head does not change with the pressure where the Pitot tubes terminate.

The pressure in the Pitot tube when the air or gas flows through the pipe is transmitted to the well, and the liquid in the helix rises in proportion to the velocity of the air or gas. For every inch of vertical rise the liquid travels about 10 in. around the well, and as this distance is graduated into 100 parts, the head can be read to 0.01 in., consequently the actual velocity of the air or gas is readily determined.

Well and helix are revolvable on the yoke so that the head of liquid in the helix can always be read, yet the connection to the pipe is not broken. Any error caused by evaporation or condensation is readily detected by turning the cock handle for an instant to a vertical position, when the liquid in the helix should return to zero, if conditions have not changed.

As a helical tube is of transparent celluloid it cannot break. Meters are tested to 100 lb. pressure, are heavily nickelplated and are manufactured by the Sargent Steam Meter Co., Chicago, Ill.

NEWS NOTES

WILLIAM SCHWANHAUSER, Chief Engineer of the International Steam Pump Company, has returned from a 3 months trip to Europe, visiting England, Germany and Russia. While in London he closed a contract with S. Pierson & Son for the entire pumping equipment required for a new oil pipe line now under construction in Mexico. The pumping engines will be furnished by the Fred M. Prescott Steam Pump Company of Milwaukee, Wisc. and the condensers and auxiliaries by Henry R. Worthington.

THE FOLLOWING COMPANIES are announced as representing the Goetze Gasket & Packing Co., in different localities: Leland & McKee Co., San Francisco, Cal.;

Geo. B. Limbert & Co., Chicago, Ill.; E. D. Morton & Co., Louisville, Ky.; Robt. McMeikan & Son, Baltimore, Md.; Alert Pipe & Supply Co., Bay City, Mich.; Southern Railway & Supply Co., St. Louis, Mo.; Simmons Pipe Bending Works, Newark, N. J.; H. H. W. Bergmann & Co., New York, N. Y.; Edward Joy Co., Syracuse, N. Y.; Merkel Bros., Cincinnati, Ohio; Shaw-Kendall Engineering Co., Toledo, Ohio; Schade Valve Mfg. Co., Philadelphia, Pa.; Empire Mine & Mill Supply Co., Pittsburgh, Pa.; Samuel Jackson Co., Pawtucket, R. I.; N. O. Nelson Co., Memphis, Tenn.; Superior Supply Co., Bluefield, W. Va.

These companies carry a large stock of Goetze Devo Gaskets, and are prepared at all times to fill promptly all orders and to protect the trade in the way of deliveries. Also having a force of salesmen well equipped for taking care of gasket problems of difficult nature the companies are in a position ably to look after the consumer's interest.

THE RATEAU STEAM REGENERATOR Company has granted a license to the Ingersall-Rand Company to manufacture the patented Rateau regulator for mixed flow turbines. The General Electric Company, the Southwark Foundry & Machine Company and the Ridgway Dynamo & Engine Company have been for some time manufacturing under a similar license from the Rateau Steam Regenerator Company.

WALTER B. SNOW, Publicity Engineer, 170 Summer Street, Boston, Mass., has added to his staff Chester R. Ross, who brings to this position an experience covering 3 years with the Griffin Wheel Co., 4 years with the Boston Transcript, and a considerable period as salesman in various lines of industry.

CATALOG NOTES

BULLETIN NO. 2, describing McEwen Bros. Blowers, has just been issued by McEwen Bros., Wellsville, N. Y. These blowers are made with 2 types of runners, helical and propeller, both for the high speeds most suitable for steam turbine drive. This bulletin also contains data and performance curves on turbine-driven blowers, showing the advantage of using blowers having economical speeds in common with those of the driving turbines.

BULLETIN 1091, recently issued by the Ideal Electric & Mfg. Co., Mansfield, Ohio, illustrates and describes its line of direct and alternating current elevator motors. The bulletin contains valuable information regarding elevator power requirements and characteristics of elevator motors.

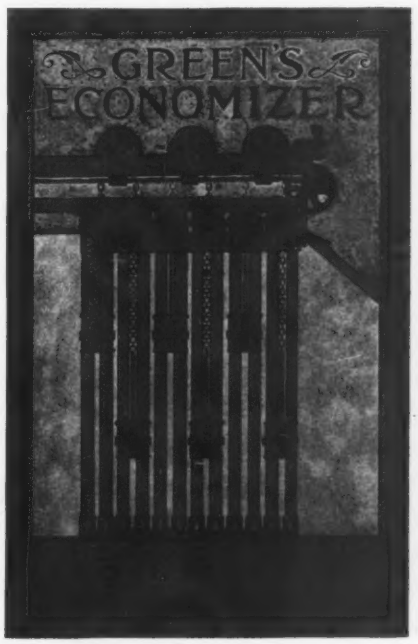
FROM LYTTON MANUFACTURING CORPORATION, Hudson Terminal Bldg., New York City, we have received bulletins illustrating and describing the Lytton boiler blow valve, pressure reducing valve for steam and air, and the Lytton vacuum traps.

THE VALVE WITH A CAP and a bushing is the name given to the American Combination Pump Valve, made by the American Mfg. & Sales Co., of Philadelphia. This and other specialties, including the Perfection Pulley Facing, the American Metal Valve Disc, and the adjustable metallic cushion packing, are described in a series of folders issued by the company.

J-M UNIVERSAL PACKING for Universal Use is the title of a pamphlet just received from H. W. Johns-Manville Co. This packing is made up in different forms for use on rods, plungers and pistons working against high and low pressure steam, hot or cold water, air, oil, ammonia, etc.

BULLETIN NO. 20, issued by the Nordberg Mfg. Co., of Milwaukee, Wis., illustrates and describes the type "S. C." Compressors made by that company. These compressors range in capacity from 200 to 1200 cu. ft. per minute, and are of the duplex belt driven type, mounted as a unit on a single base. The bulletin describes the compressor in detail, giving the principal features of construction.

GREEN'S ECONOMIZER is an interesting device, both in its mechanical operation and in the effects which it produces. The description given in the handsome book just issued by the Green Fuel Economizer Co., of Matteawan, N. Y., makes it doubly interesting, not only because of the clear and concise description, but because of the facts in regard to efficiency of heating water, the amount of air required for combustion, efficient methods of absorbing heat from hot gases, and other data and



charts contained in the book. The discussion shows the lowest temperature to which it pays to cool gases by means of boiler surface and that a lower temperature may economically be obtained by use of the economizer. It shows also a specific instance in which the water entered the boiler at a temperature higher than that of the gases leaving the economizer, due to the employment of the counter current principle of heating. It is a book which will not only attract the eye and satisfy one's liking for beautiful things, but will also instruct and assist in efficient operation of the plant.

GENERAL ELECTRIC COMPANY has just issued Bulletin No. 4966, devoted to hydro-electric power developments. Following a brief description, various important developments of this nature are given—some of them in considerable detail, and the bulletin contains numerous illustrations of both station and line construction.

BULLETIN 4962, recently issued by the General Electric Company, is devoted to the use of electric power in the lumber and woodworking industries. The bulletin contains illustrations of installations of motors used in connection with various branches of the industry.

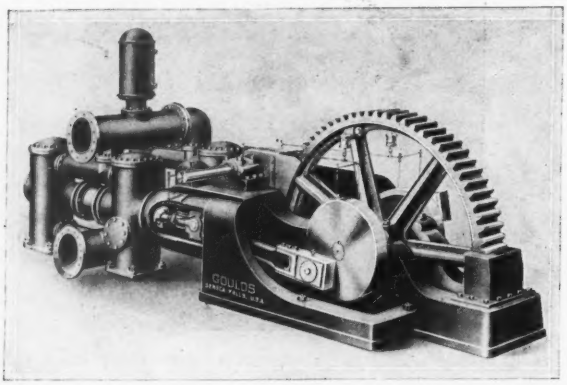
IN BULLETIN 4953, entitled "Large Shell Type Transformers," and recently issued by the General Electric Company, the Company endeavors to place before those interested some of the more important points regarding the relative merits of its different types of transformers.

413,637 HORSEPOWER and Over 1600 Satisfied Users is the striking title of a book issued by the Stewart Heater Co. of Buffalo, N. Y., giving some of the plants where the Otis feed water heaters and purifiers are in use and also some of the things that have been said about these heaters by those having them in operation. In the back is given the guarantees which are made in regard to the Otis water purifying system for steam boilers and these guarantees are of such nature and such strength that they will be found of interest to everyone who wishes to improve the efficiency of his plant.

TRADE NOTES

THE ILLUSTRATION shows a new type of horizontal duplex, double acting Power Pump for large capacity service in water works and isolated plants, which is being placed on the market by The Goulds Manufacturing Co., of Seneca Falls, N. Y. As shown, the pinion shaft is extended for direct connection to an electric motor, steam or internal combustion engine or other driver.

The power end is provided with a single gear and pinion; the gear is of the split pattern type and made of cast iron, the pinion of forged steel. The teeth in both the gear and pinion are machine cut from the solid



metal. Three heavy cast-iron girder sections, each carrying a main bearing and crosshead, are doweled and bolted together to form the frame. The crossheads are cast iron with babbitted shoes which have wedge and screw adjustment, working in bored guides.

The water end consists of 4 castings, each of which contains a plunger chamber, a discharge chamber, and a suction chamber. These castings are held together by large flanged suction and discharge connections, and are bolted to the main frame through the front cylinder.

AMONG RECENT ORDERS RECEIVED by the Westinghouse Electric & Mfg. Company are the following: Oakland, Antioch & Eastern Railroad Company, San Francisco, Calif., for 2 750-kw., 1300-volt d.c. 1080 hp., 11,000-volt a.c. 3-phase, 60-cycle, 514 r.p.m. 2 bearing synchronous motor-generator sets, together with 2 5-panel switchboards for controlling them. The Rochester Railway & Light Company, Rochester, N. Y., for 1 3-unit, 4-bearing motor generator consisting of 1 145-kw., 120-volt, d.c. generator, also 1 45-kw., 80-volt, d.c. generator driven by 1 285-hp., 4150-volt, 3-phase, 60-cycle, 900 r.p.m. synchronous motor. The Cincinnati Traction Co., Cincinnati, Ohio, for 50 double equipments of No. 318 motor and K40-A control. The Peninsular Railway Company, San Jose, Calif., for 8 quadruple equipments of No. 333B-2 motors designed for operation on 600-1200-volt circuits with A-L-F control. Pacific Electric Company, Los Angeles, Calif., for 45 quadruple equipments of No. 333B-2 motors designed for operation on 600-1200-volt circuits and A-L-F control.

ONE OF THE LARGEST oil contracts ever given out by the Navy Department has been landed by the William C. Robinson & Son Company, 1503 Thames Street, Baltimore. The contract calls for several hundred thousand gallons of marine turbine lubricating oil, marine turbine oil and machine oil, and means an annual increase of revenue to the Robinson Company of from $50,000 to $60,000. The contract became effective on July 1, 1912, and is for one year, the company being required to supply all ships that have turbines and forced feed lubrication. To deliver the oil the company will be required to ship several hundred carloads to all the navy-yards on the Atlantic seaboard.

KROESCHELL BROS., 444 W. Erie street, Chicago, Ill., makers of the "Ideal" chain wrenches are distributors to the trade of a pocket chart giving quick and accurate rules for obtaining 45 deg. offsets. They will gladly send a copy to engineers, plumbers and steamfitters if you address them, mentioning Practical Engineer.

YORK MANUFACTURING CO. reports the recent installation of the following plants: The Knickerbocker Ice Company, Chicago, Ill., one 250-ton vertical single acting refrigerating machine, cross compound engine; also one 35-ton horizontal double acting refrigerating machine; Vogt Brewing Company, Erie, Pa., one 30-ton horizontal double acting refrigerating compression side, and direct expansion refrigerating plant; Frank Pizini, San Antonio, Texas, one 6-ton belt driven refrigerating compression side, and direct expansion refrigerating plant; The Kent Co., Ltd., Montreal, Canada, one 2-ton belt driven refrigerating compression side, refrigerating plant and brine system, for the Canadian Pacific Railway Co., Demonstrating Farm, Stahmore, Alberta, Can; E. S. Nelson, Stockton, Ala., one 4-ton belt driven refrigerating compression side, and one 2-ton can ice making plant, and distilling system; Peter Stubler, Oil City, Pa., one 4-ton belt driven refrigerating compression side and refrigerating plant; Wegner Machine Co., Buffalo, N. Y., 20,000 feet of 2-in. direct expansion piping for cold storage rooms, also 3 stands double pipe ammonia condensers 12 pipes high; ammonia receiver and vertical ammonia accumulator with internal liquid cooling coil, to be installed for the Wilson Cold Storage Company, Wilson, N. J.; M. H. Renken & Co., Brooklyn, N. Y., one 11-ton steam driven refrigerating compression side, and refrigerating plant; Eastman Kodak Co., Rochester, N. Y., 6 shell and tube heaters 6 ft. in diameter by 21 ft. 6 in. long; 42 atmospheric air cooling coils arranged in 6 batteries, 7 coils each, 12 pipes high by 20 ft. long, also two 80-ton refrigerating "1912" style shell and tube brine coolers, with 2 vertical ammonia accumulators, 42 in. diameter by 7 ft. long, each provided with internal liquid cooler; Consumers Ice Co., Tampa, Fla., 16,000 ft. of 1¼-in. brine piping and mains for storage house; Kent Co., Ltd., Montreal, Canada, one 11-ton refrigerating compression side and refrigerating plant for T. Eaton Co., Winnipeg, Manitoba, Can.

Sparks From The Advertising Pages

A prominent advertising manager in his monthly chat with the readers of a well-known fiction magazine calls the advertising pages of any good publication a "bonus." He says that the subscriber pays for the editorial and reading matter and that whatever there is of value to the reader in the advertising section is a bonus, pure and simple.

Webster defines the word bonus as a "premium" or an "extra dividend"—something which is given in addition to a stipulated amount.

Now, granting that our advertising manager is right and that you do buy Practical Engineer exclusively because of the contents of its editorial and news pages, how much of a bonus are you getting out of the advertising section? Does it constitute a real, twice-a-month "extra dividend" or is it something which is only now and then casually interesting?

Like many good things, the value of the advertising section depends largely upon what you make of it. There is a genuine opportunity for real extra value to you personally, but it remains for you to grasp that opportunity—to get the benefit of the extra dividend.

A now-and-then, casual glance through the advertising section may lead you to find something once in a while that will be of aid to you, but in the long run you are missing a lot—passing up a good thing.

There's something new being advertised in most every number that in most cases you would want to know about. New machinery along improved lines—new steam specialties with new functions—new methods for cutting down expense—news of these things is there for you if you're looking for your "bonus."

Just how big and how valuable this bonus is, depends entirely upon the regularity and conscientiousness with which you study the advertisements. Casual glances overlook many a product that might have proven a great help.

There's a broadening effect, too, that results from a knowledge of the progress that's being made in your profession. It makes you enthusiastic and enthusiasm lends interest to your work.

If you're the least bit skeptical about this, try it now and find out for yourself whether or not it's really profitable to be a close student of the advertising section.

Take your last number of Practical Engineer and read the advertisements thoroughly. Note the ones which you found to be of more than passing interest. It won't be long before you're working your "bonus" to the limit.

PRACTICAL ENGINEER CLASSIFIED ADVERTISEMENTS

Advertisements in this section are inserted under regular headings at the rates of 30 cents per line. About nine words make a line. No display type allowed, but the first three words may be set in capital letters. Minimum space sold, two lines.

Under classification, "Positions Wanted," advertisements not exceeding four lines will be inserted for subscribers once free of charge.

To insure proper classification, copy must reach this office 10 days preceding publication.

Positions Wanted

POSITION WANTED—By young man as oiler or engineer helper. Strictly sober and reliable man. Willing worker. Address Box 249 care of Practical Engineer, Chicago, Ill. 10-1-1

POSITION WANTED—Chief Engineer desires change, extensive experience in charge of power, heating and refrigeration plants. Address Box 247 Practical Engineer, Chicago, Ill. 10-1-1

POSITION WANTED—By A1 reliable engineer. Understands slide valve, Corliss and equipment, condensers, plant lighting, etc. Address Box 197, Jennings, La. 9-15-2

POSITION WANTED—In small power plant or mill as oiler or fireman. Four years' experience with tractions. Handy with tools. An all around man. Sober. Single. Please give full details in reply. Address E. B. Stewart, Racine, Minn. 10-1-2

POSITION WANTED—By A1 engineer. Understands slide valve and Corliss engines, lighting plants. Have handled 12-ton ice plant, compression system. Address Box 248 care of Practical Engineer, Chicago, Ill. 10-1-2

POSITION WANTED—Engineer 31, married, with 10 years' experience with steam engines, dynamos, ice machines, turbines, etc. Wants steady position, Rhode Island or the state of Connecticut preferred. Address Box 245 care of Practical Engineer, Chicago, Ill. 9-15-2

POSITION WANTED—Experienced steam-electrical engineer will consider position of engineer in charge or superintendent of light plant in a small town. Iowa or Nebraska preferred. Iowa license. Reference furnished. Address Box 246 care of Practical Engineer, Chicago, Ill. 9-15-2

Help Wanted

HELP WANTED—ENGINEER WANTED in every city and town to instruct our customers in indicator practice. If you have a fair working knowledge, we will "do the rest." Good pay to reliable, intelligent men. Write for particulars. Lippincott Co., Newark, N. J. tf

Wanted

WANTED—To purchase patent on engine room specialty or anything new in power plant equipment. Address F. D. Nostrand, Patchogue, New York. 10-1-1

WANTED—ALL STEAM USERS to have clean boilers without using compounds or chemicals in any form. Write "Otis," No. 317 Norfolk Ave., Buffalo, N. Y. tf

WANTED—January 1910 issues of Practical Engineer. Your subscription extended 6 months for every copy of this issue sent us. Offer good until Nov. 1st, 1912. 10-1-2

WANTED EVERY ENGINEER to have our pamphlet for setting valves on Corliss Engines, simple and compound, with one or two eccentrics. Sent free. Lindstrom's Machine Works, 200 South Third St., Allentown, Pa. tf

IF YOU ARE a night engineer, spend a few hours each day taking subscriptions for Practical Engineer. You will be paid well. Write the Subscription Dept. They will start you in at once. tf

WANTED—SALESMEN TO WORK counties calling on voters for our New Census publications. Largest publishing house in the world back of you. Permanent if satisfactory. Establish your future now. Men making $50 to $75 per week. Rand McNally & Co., Dept. B, Chicago, Ill. 8-1-5

For Sale

FOR SALE—New 30 H. P. Ball Automatic Horizontal engine. Lucas & Son, Bridgeport, Conn. 9-15-6

FOR SALE—INDICATOR REDUCING WHEEL, planimeter, best make, in fine order. Examination allowed before payment; price low—in fact, a sacrifice. Address Mrs. N. L. Browning, East Orange, N. J. tf

Patents and Patent Attorneys

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owens, 28 Owen Bldg., Washington, D. C. tf

PATENTS BRING WEALTH; proof—books—advise—Free. Low rates, easy terms. A. Wedderburn, Pat. Atty., Washington, D. C. 9-15-3

WE SELL PATENTS. Established ten years. To buy or having one to sell write Charles A. Scott Co., 1098 Granite Bldg., Rochester, N. Y. 8-1-6 e.o.i.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 608 F. St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. tf. e.o.i.

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. tf

THE PATENTOME is interesting and instructive. A liberal education in patents and how to get them. Free on request. Established 1865. Anderson and Son, Patent Solicitors, 710 G St., Washington, D. C. 10-1-2

FIND OUT FOR YOURSELF what to invent and how to procure and sell a patent for the same. My book, "Inventor's Universal Educator," covers the matter from A to Z. 140 pages, elegantly bound. Also contains 600 mechanical movements and 50 perpetual motions. Price $1.00, postage free. Money returned if not more than satisfactory. F. G. Dieterich, 618 Ouray Bldg., Washington, D. C. 10-1-2

Educational and Instruction

A SWINGLE'S TWENTIETH CENT'Y Hand Book Free to the subscriber who writes the best 750 word article on the reading matter he likes best in Practical Engineer, and why? Address the Contest Editor. 9-15-3

Miscellaneous

IRON, BRASS and Aluminum Castings, Metal Specialties, Patterns, Models, Polishing, Plating and Japanning, North Chicago Tool Works, 65 Grove Ave., North Chicago, Ill. 6-1-12

MAKE MONEY on the side. Here's your chance to pick out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you how. tf